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THE

VOYAGE OF H.M.S. CHALLENGER.

ZOOLOGY—VOL. XVI.

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REPORT

ON THE

SCIENTIFIC RESULTS

OF THE

VOYAGE OF H.M.S. CHALLENGER

DURING THE YEARS 1873-76

UNDER THE COMMAND OF

CAPTAIN GEORGE S. NARES, R.N., F.R.S.

AND THE LATE

CAPTAIN FRANK TOURLE THOMSON, R.N.

14595

PREPARED UNDER THE SUPERINTENDENCE OF

THE LATE

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AND NOW OF

JOHN MURRAY

ONE OF THE NATURALISTS OF THE EXPEDITION

PRESENTED BY HER MAJESTY'S GOVERNMENT

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I.—Report on the Cephalopoda collected by H.M.S. Challenger during the years 1873–1876.

By William Evans Hoyle, M.A. (Oxon.), M.R.C.S., F.R.S.E., Naturalist on the Editorial Staff of the Challenger Reports.

(*The Manuscript was received in Instalments between* 20*th January and* 30*th April* 1886.)

II.—Report on the Stomatopoda collected by H.M.S. Challenger during the years 1873–1876.

By W. K. Brooks, Associate Professor of Zoology and Director of the Marine Laboratory of the Johns Hopkins University, Baltimore, U.S.A.

(*The Manuscript was received* 31*st December* 1885.)

III.—Report on the Reef Corals collected by H.M.S. Challenger during the years 1873–1876.

By John J. Quelch, B.Sc. Lond., Late Assistant, British Museum; Curator of the British Guiana Museum, Georgetown, Demerara.

(*The Manuscript was received in Instalments between* 8*th February and* 28*th April* 1886.)

IV.—Report on the Human Crania and other Bones of the Skeletons collected during the Voyage of H.M.S. Challenger, in the years 1873–1876. Second Part.

By Sir William Turner, Knt., M.B., LL.D., F.R.S.S. L. & E., Professor of Anatomy in the University of Edinburgh, Foreign Member of the Anthropological Society of Paris.

(*The Manuscript was received in instalments between* 5*th May* 1885 *and* 15*th July* 1886.)

EDITORIAL NOTES.

This Volume contains Parts XLIV., XLV., XLVI., and XLVII. of the Zoological Series of Reports on the Scientific Results of the Expedition.

Part XLIV.—Professor T. H. Huxley at one time proposed to undertake the description of the Cephalopoda brought home by the Expedition. His many engagements, however, compelled him to give up this intention, so far as regards the whole collection, but he retained, and is now engaged in the preparation of a Report on, the genus Spirula. The remainder of the Cephalopod collection was placed in the hands of Mr. W. E. Hoyle, in 1883, soon after his appointment as Naturalist on the Editorial Staff of the Challenger Reports.

The results of Mr. Hoyle's investigations are given in this part, which, in addition to the description of many new forms, will be found to contain an able revision of our knowledge of existing species up to the present time.

Part XLV.—The collections of Stomatopoda were placed in the hands of Professor W. K. Brooks of Johns Hopkins University, for examination and description, some years after the return of the Expedition. The collections contained few adult specimens, but were rich in larval forms obtained at the surface of the ocean in many different localities, by means of tow-nets. Professor Brooks has thus been enabled to make a more extensive survey than heretofore of the relations between larvæ and adults, and to elucidate many points in their complicated life history. The Report thus forms a valuable contribution to a difficult subject, and will be welcomed by all Naturalists.

Part XLVI.—The collection of Reef-Corals formed during the Expedition was a relatively small one, being chiefly made up of a few specimens from each of the localities visited. When, however, the collection was compared with that in the British Museum it was found to be of much greater interest than was at first supposed. Mr. John J. Quelch, B.Sc., who made this comparison, was consequently induced to prepare the present detailed Report, which contains, in addition to the descriptions of new species, an important contribution to our knowledge of the geographical distribution of these animals.

Part XLVII.—This is the second part of the Report on the Human Crania and other Bones of the Skeleton, by Professor Sir William Turner, Knt., F.R.S. As in the first part of the Report, dealing with the Crania, Sir William Turner has not limited his investigations to a description of the Skeletons actually collected by the Expedition, but has embodied in his research an account of a number of other Skeletons, and the descriptions of preceding writers. The whole Report thus forms a valuable contribution to the Comparative Osteology of the Races of Man.

John Murray.

Challenger Office, 32 Queen Street,
Edinburgh, 15*th August* 1886.

ERRATA.—PART XLIV.

Page 14, line 8 from bottom, *for* "vol. iv." *read* "vol. vi."
Page 67, at the top of the page insert "Division II. **Trachyglossa**, Lütken."
Page 68, line 7 from bottom, *for* "*Bobitæna*" *read* "*Bolitæna*,"
Page 136, line 6, *for* "Gray" *read* "Quoy."
Page 217, line 4 from bottom, *for* "*Monchezia*" *read* "*Mouchezia.*"
Page 219, after line 20, insert "*Architeuthus martensi.*"
Page 220, footnote, *for* "d'Abigny" *read* "d'Orbigny."

THE

VOYAGE OF H.M.S. CHALLENGER.

ZOOLOGY.

REPORT on the CEPHALOPODA collected by H.M.S. Challenger during the years 1873–76. By WILLIAM EVANS HOYLE, M.A. (Oxon.), M.R.C.S., F.R.S.E., Naturalist on the Editorial Staff of the Challenger Reports.

PREFACE.

ON the return of the Challenger the whole collection of Cephalopoda was placed by Sir Wyville Thomson in the hands of Professor Huxley for examination and description, and it will be regretted by all naturalists that this Report was not prepared by that eminent master in the science of comparative anatomy. Professor Huxley's numerous engagements, however, prevented him from undertaking more than the investigation of the single specimen of *Spirula* which was obtained by the Expedition. The remainder of the collection was offered to me by Mr. John Murray in the autumn of 1882, and within the first few weeks of 1883 I received the specimens from South Kensington. Since that period almost all my spare time has been occupied in the work of drawing up the present Report.

The lack of any collection of Cephalopoda in Edinburgh rendered progress slow at first, but in the summer of 1884, by the invitation of Professor Steenstrup, I took the Challenger specimens over to Copenhagen and spent a month in comparing them with the unrivalled collection in the Zoological Museum of that city. I have also paid two visits to the British Museum, and one of only a day or two in duration to the Museum of the Jardin des Plantes in Paris. In this connection I must express my thanks in the first place to Mr. John Murray for having placed so important and interesting a

piece of work in my hands, and for the kindness and consideration with which he has at all times assisted me in carrying it out. I am indebted also to Dr. Günther and Mr. Edgar A. Smith for facilitating my examination of the National Collection, and to the latter gentleman in particular for notes and comparisons which he has been good enough to make for me. In addition, my thanks are due to Professor E. Ray Lankester, F.R.S., to Dr. Paul Fischer, and to my friend Dr. Georg Pfeffer for having courteously answered a number of questions regarding specimens in their charge; to Dr. Jatta of the Naples Zoological Station; to Dr. P. H. Carpenter, F.R.S., for information regarding the cruise of the "Porcupine"; to Dr. A. T. de Rochebrune for having shown me several of the valuable type specimens in the Museum of the Jardin des Plantes; and to Dr Murie, the able librarian of the Linnean Society, for assistance in the bibliography of the subject.

No ordinary acknowledgment, however, is sufficient to indicate the extent of my obligation to my good friend Professor Steenstrup; not only did he allow me during my sojourn in Copenhagen the greatest freedom of access to the invaluable collection under his charge, but also gave up many hours to assist me in the work of comparison, and since my return he has been good enough to answer numerous questions regarding points of uncertainty or confusion, and has read over the proofs of this Report, which has thus been saved from many errors, which it must otherwise have contained.

In addition to the Challenger collection the present memoir treats of those obtained by H.M.SS. "Porcupine," "Knight Errant," and "Triton;" those from the two latter expeditions were placed in my hands by Mr. John Murray, while the specimens collected by the "*Porcupine*," which had been handed by the late Dr. Gwyn Jeffreys to Professor Steenstrup, were transferred by him to me that they might be treated of along with the others; a few specimens from the "Valorous" Expedition were also received with them.

The present Report is almost exclusively systematic in its scope, but I hope to be able within a year to prepare a Supplement giving an account of the anatomical examination of those specimens which are available for the purpose.

The ten years which have now elapsed since the *return* of the Challenger, have to some extent impaired the novelty of this Report; in that interval marine zoological investigation in general, and deep-sea dredging in particular, have been so energetically prosecuted, that no less than five genera which were first collected by the Challenger have been since described from other sources.[1]

[1] *Alloposus, Eledonella, Inioteuthis, Mastigoteuthis, Calliteuthis.*

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EXPLANATION OF THE PLATES.

A PROVISIONAL SYNOPSIS OF RECENT CEPHALOPODA.

THE latest attempt to give a complete systematic account of the Cephalopoda is that of Tryon, published in 1879;[1] but it labours under several disadvantages—the first and most serious being that the author has given almost all his attention to Conchology properly so-called, and has apparently treated the Cephalopods rather with a view of making his Manual complete than from any special interest in them; secondly, the mode of arrangement adopted of placing all the synonymy in the form of an alphabetical index at the end of the volume renders it exceedingly difficult to ascertain what he includes under each species, and, furthermore, a large number of new forms have been described since the publication of his work, and several important contributions have been made to our knowledge of the relations of previously described groups.

Under these circumstances it appeared that the compilation of such a list as the present, even though it might fail, indeed necessarily must fail, to give a completely satisfactory survey of the class, would nevertheless be of considerable use to workers in this interesting branch of Malacology, were it only as a reliable index to the literature of the subject, and I therefore resolved to draw up in a form fit for publication the material gathered for use in my own investigations, and received Mr. Murray's assent to its being included in the present Report. I should, however, be doing injustice to Mr. Tryon did I not acknowledge my indebtedness to his elaborate and careful index.

At present no systematic treatment of the whole class of Cephalopoda can hope to be other than provisional, such a large percentage of the published descriptions of species being inaccurate or insufficient for modern requirements, that nothing satisfactory can be obtained until some worker shall do for this group what Lyman did for the Ophiuroidea and Agassiz for the Echini,—travel to the various museums and re-examine all such type specimens as are at present extant; and in the present instance it would be particularly desirable that he should have the opportunity of comparing the different specimens side by side.

With respect to the list itself, I have endeavoured to give a reference to the original creation of each species and such others as might be necessary to indicate the important points in its history, or good descriptions and figures of it; save in one or two cases of

[1] Manual of Conchology, vol. i.

special interest, I have not attempted to give complete synonymies. I have especially avoided registering species as identical without such evidence as seemed to me absolutely conclusive, for, so far from tending to simplicity and clearness, hasty and indiscriminate identifying of species can only lead to the utmost confusion. It is too much to hope that there should be no mistakes in the references, but every care has been taken to reduce them to a minimum; with the exception of a few, where the contrary is distinctly stated, they have all been personally verified by myself.

The Classification adopted is not identical with any previously published, but I have endeavoured to select what was best from the works of my predecessors, modifying their results when it seemed necessary. A systematic arrangement of this class, based on a complete knowledge of their anatomy and development, as well as of their external characters, is still and will long remain a desideratum.

The present list contains 388 species, which are disposed in 68 genera, and these in 14 families; of which numbers 32 species, 4 genera, and 1 family are new to science. Of these at least 60 or 70 species have been inadequately characterised, so that it is unlikely that they could be recognised from the published descriptions, and the same is true of several of the genera; hence it may be said in round numbers that we are acquainted with 50 genera of recent Cephalopoda containing 300 species. It is worthy of remark that 29 or half the genera contain only one species each, while nearly one-half the species (170) belong to the three genera *Octopus*, *Sepia*, and *Loligo*.

Class CEPHALOPODA, Cuvier.

Siphonopoda, Lankester.

Order I. DIBRANCHIATA, Owen, 1832.

Suborder I. OCTOPODA, Leach, 1818.

Division 1. Lioglossa,[1] Lütken, 1882.

Family I. Pteroti, Reinhardt et Prosch.

Cirroteuthidæ, Keferstein.

Cirroteuthis, Eschricht, 1836.

Sciadephorus, Reinhardt et Prosch, 1846.
Bostrychoteuthis, Agassiz, 1846.

1. *Cirroteuthis mülleri*, Eschricht.

   1836. *Cirroteuthis Mülleri*, Eschr., Nova Acta Acad. Cæs. Leop.-Carol., t. xviii. p. 627, tabb. xlvi.–xlviii.
   1846. *Sciadephorus Mülleri*, Reinh. og Prosch, Om Sciadephorus Mülleri,[2] Kjøbenhavn.

2. *Cirroteuthis umbellata*, Fischer.

   1883. *Cirroteuthis umbellata*, Fischer, Journ. de Conch., t. xxiii. p. 402.

3. *Cirroteuthis magna*, Hoyle (Pl. XI. figs. 3–5; Pl. XII.; Pl. XIII. figs. 1–4; p. 56).

   1885. *Cirroteuthis magna*, Hoyle, Diagnoses I., p. 233.

4. *Cirroteuthis pacifica*, Hoyle (Pl. X.; p. 61).

   1885. *Cirroteuthis pacifica*, Hoyle, Diagnoses I., p. 235.

5. *Cirroteuthis meangensis*, Hoyle (Pl. IX. figs. 12, 13; Pl. XI figs. 1, 2; Pl. XIII. figs. 5, 6; p. 63).

   1885. *Cirroteuthis meangensis*, Hoyle, Diagnoses I., p. 234.

6. *Cirroteuthis plena*, Verrill.

   1885. *Cirrhoteuthis plena*, Vll., Third Catal., p. 404, pl. xlii. fig. 3.

7. *Cirroteuthis megaptera*, Verrill.

   1885. *Cirrhoteuthis megaptera*, Vll., Third Catal., p. 405, pl. xliii. figs. 1, 2.

[1] Without a radula (Dyreriget, p. 543, Kjøbenhavn, 1881–82).
[2] *K. dansk. Vidensk. Selsk. Afhandl.*, Bd. xii. pp. 185–224, tabb. i.–v.

Stauroteuthis, Verrill, 1879.

1. *Stauroteuthis syrtensis*, Verrill.

1879. *Stauroteuthis syrtensis*, Vll., Amer. Journ. Sci. and Arts, vol. xviii. p. 468.
1881. „ Vll., Ceph. N. E. Amer., p. 382, pl. xxxii. figs. 1–5.

Opisthoteuthis, Verrill, 1883.

1. *Opisthoteuthis agassizii*, Verrill.

1883. *Opisthoteuthis Agassizii*, Vll., "Blake" Suppl., p. 113, pl. i. fig. 1; pl. ii. fig. 1.

Division 2. Trachyglossa, Lütken,[1] 1882.

Family II. Amphitretidæ, n. fam.

Amphitretus, Hoyle, 1885.

1. *Amphitretus pelagicus*, Hoyle (Pl. IX. figs. 7–9; p. 67).

1885. *Amphitretus pelagicus*, Hoyle, Diagnoses I., p. 235.

Family III. Argonautidæ, Cantraine, 1841.

Argonauta, Linné,[2] 1756.

Ocythoë, Leach et Auctt. (*non* Rafinesque).

1. *Argonauta argo*, Linné (p. 69).

1758. *Argonauta argo*, Linn., Syst. Nat., ed. x. p. 708; No. 282, 231.
1817. „ *haustrum*, Dillwyn, Descr. Catal., p. 335 (=*forma aurita*).
1838. „ *argo*, d'Orb., Céph. acét.; Argonaute, pl. ii. figs. 1, 2.
1853. „ *Gruneri*, Dunker, Zeitschr. f. Malak., 1852, p. 48 (=*forma mutica*).
1861. „ „ Reeve, Conch. Icon., pl. iii. fig. 2*b* (=*forma mutica*).
1861. „ *argo*, Reeve, Conch. Icon., pl. iii. fig. 2*c*.
1861. „ *haustrum*, Reeve, Conch. Icon., pl. ii. (=*forma aurita*).

2. *Argonauta tuberculata*, Shaw.

... *Argonauta tuberculatus*, Shaw, Nat. Miscell., vol. xxiii. tab. 995.[3]
1786. „ *nodosa*, Solander, Portl. Catal., 76, 2120 (vol. ii. p. 113).
1786. „ *navicula*, Solander, Portl. Catal., 42, 1055 (=*formâ aurita*) (vol. ii. p. 112).
1787. „ *argyata*, Meuschen, Mus. Gevers., 252, No. 133.
1817. „ *gondola*, Dillwyn, Descr. Catal. (=*forma aurita*).
1822. „ *tuberculosa*, Lmk., Anim. s. vert., t. vii. p. 652.
1861. „ „ Reeve, Conch. Icon., pl. i. (=*forma mutica*).

[1] *Op. cit.*, p. 543. As I did not feel justified in removing the buccal organs from the small solitary specimen of *Amphitretus pelagicus* in the collection, I am unable to say whether it belongs to the Trachyglossa or the Lioglossa.

[2] Having had no opportunity of forming an independent opinion as to the values of the various recorded species of Argonaut, I have followed von Martens (*Ann. and Mag. Nat. Hist.*, ser. 3, vol. xx. p. 103, 1867), and added such other species as have been described since the publication of that paper.

[3] I have been unable to ascertain beyond doubt when this was published, for the volume bears no date. Dillwyn (*op. cit.*, p. xi.) gives 1790; if this be correct Solander's name should take precedence.

3. *Argonauta hians*, Solander.

1786. *Argonauta hians*, Solander, Portl. Catal., p. 44, lat. 1055 (vol. ii. p. 113).[1]
1822. „ *nitida*, Lmk., Anim. s. vert., t. vii. p. 653.
1850. „ *Owenii*, Ad. and Rv., Voy. "Samarang," Moll, pl. iii. fig. 1:
1850. „ *gondola*, Ad. and Rv., *Op. cit.*, pl. ii.
1852. „ *Kochiana*, Dunker, Zeitschr. f. Malak., p. 49 (= var.).
1861. „ *gondola*, Reeve, Conch. Icon., pl. iv. figs. 3*a*, 3*b*.

4. *Argonauta pacifica*, Dall.

1872. *Argonauta pacifica*, Dall, Amer. Journ. Conch., vol. vii. p. 95.

5. *Argonauta expansa*, Dall.

1873. *Argonauta expansa*, Dall, Proc. Calif. Acad., N.S., vol. iv. p. 303.

6. *Argonauta bættgeri*, Maltzan.

1881. *Argonauta Bættgeri*, Maltzan, Journ. de Conch., t. xxix. p. 163, pl. ix. fig. 7.

7. *Argonauta gracilis*, Kirk.

1885. *Argonauta gracilis*, Kirk, Trans. N. Zeal. Inst., vol. xvii. p. 58, pl. xiii.

Ocythoë, Rafinesque, 1814 (*non* Leach et auctt.).

Parasira, Steenstrup.

1. *Ocythoë tuberculata*, Rafinesque.[2]

1814. *Ocythoë tuberculata*, Raf., Précis découv. somiol., p. 29.
1828. *Octopus catenulatus*, Fér., Céph. acét.; Poulpes, pl. vi. *bis et ter*.
1837. „ *Carena*, Vér., Mem. Accad. Sci. Torino, ser. 2, t. i. p. 92, pl. ii.
1838. *Philonexis tuberculatus*, d'Orb., Céph. acét., p. 87; Poulpes, pl. vi. *bis et ter*, pl. xxiii.
1840. *Ocythoë tuberculata*, Raf., Good Book, p. 63.
1849. *Philonexis Alcœus* (?), Gray, B.M.C., p. 26.
1851. *Octopus catenulatus*, Vér., Céph. médit., p. 37, pl. xiii.
1851. „ *Carena*, Vér., Céph. médit., p. 34, pl. xiv. figs. 2, 3; pl. xli. figs. 1, 2.
1861. *Parasira catenulata*, Stp., Vid. Meddel. nat. Foren. Kjøbenhavn, Aar 1860, p. 333.
1869. „ „ Targ., Cef. Mus. Firenze, p. 11.
1869. „ *tuberculata*, Targ., *Op. cit.*, p. 13.
1880. *Ocythoë tuberculata*, Stp., Ommat. Blækspr., p. 104.
1881. *Parasira catenulata*, Vll., Ceph. N. E. Amer., p. 362, pl. xxxiii. fig. 2.

[1] I have not had an opportunity of seeing the Portland Catalogue but the references in brackets are taken from a copy of Solander's MS. in the Linnean Society's Library, for the knowledge of which I am indebted to Dr. Murie; it was written by Humphreys and was formerly in the possession of G. B. Sowerby, from whom it was purchased for the sum of £5.

[2] It seems very improbable that this is the *Octopus tuberculatus* of Risso (Hist. Nat. Eur. Mérid., t. iv. p. 3, 1826); his description does not seem to me applicable to this form, in addition to which we have Verany's statement (Céph. médit., p. 40) that Risso did not recognise the drawing of *Octopus catenulatus* (*op. cit.*, pl. xiii.) as his species. There can, however, be no doubt that, as Steenstrup has recently pointed out (*loc. cit.*), this is the species which Rafinesque had in view in constituting the genus *Ocythoë*, which Leach and others have always understood to be the animal of the Argonaut, which Rafinesque clearly states was not the case (Good Book, *loc. cit.*).

Family IV. PHILONEXIDÆ, d'Orbigny, 1838.

Tremoctopus, delle Chiaje, 1830.

Philonexis, d'Orbigny.

1. *Tremoctopus violaceus*, delle Chiaje.

1830. *Tremoctopus violaceus*, d. Ch., Mem. stor. nat., pl. lxx. (*fide* Vér.).
1830. *Octopus velifer*, Fér., Poulpes, pls. xviii., xix. (*nomen tantum*).
1837. „ *velatus*, Rang, Mag. de Zool., cl. v. p. 60, pl. lxxxix.
1838. *Philonexis velifer*, d'Orb., Céph. acét., p. 91; Poulpes, pls. xviii.–xx., pl. xxiii. figs. 2–4.
1851. *Tremoctopus velifer*, Vér., Céph. médit., p. 41, pl. xiv. fig. 1.
1851. *violaceus*, Vér., *Ibid.*, p. 41, pls. xv., xvi.

2. *Tremoctopus quoyanus* (d'Orbigny), Steenstrup (Pl. XIII. fig. 7; p. 70).

1835. *Octopus* (*Philonexis*) *Quoyanus*, d'Orb., Amér. mérid., p. 17, pl. ii. figs. 6–8.
1838. *Philonexis Quoyanus*, d'Orb., Céph. acét., p. 96; Poulpes, pl. xvi. figs. 6–8, pl. xxiii. fig. 5.
1861. *Tremoctopus Quoyanus*, Stp., Vid. Meddel. nat. Foren. Kjøbenhavn, Aar 1860, p. 332.

3. *Tremoctopus gracilis* (Eydoux et Souleyet), Tryon (Pl. XIII. figs. 8, 9; p. 71).

1852. *Octopus gracilis*, E. et S., Voy. "Bonite," p. 13, pl. i. figs. 8, 9.
1879. *Tremoctopus gracilis*, Tryon, Man. Conch., vol. i. p. 131.

4. *Tremoctopus atlanticus* (d'Orbigny), Steenstrup (p. 71).

1835. *Octopus* (*Philonexis*) *atlanticus*, d'Orb., Amér. mérid., p. 19, pl. ii. figs. 1–4.
1838. *Philonexis atlanticus*, d'Orb., Céph. acét., p. 98; Poulpes, pl. xvi. figs. 4, 5.
1861. *Tremoctopus atlanticus*, Stp., Vid. Meddel. nat. Foren. Kjøbenhavn, Aar 1860, p. 332 (*err. typ.*).

5. *Tremoctopus microstomus* (Reynaud), Tryon.

1830. *Octopus microstomus*, Reynaud, Mag. de Zool., cl. v. p. 23, pl. xxiii.
1838. *Philonexis microstomus*, d'Orb., Céph. acét., p. 100; Poulpes, pl. x. fig. 5.
1851. *Octopus Koellikeri* (?), Vér., Céph. médit., p. 33, pl. xi. figs. A, B, C.
1879. *Tremoctopus microstomus*, Tryon, Man. Conch., vol. i. p. 130.

6. *Tremoctopus hyalinus* (Rang), Tryon.

1837. *Octopus hyalinus*, Rang, Mag. de Zool., cl. v. p. 66, pl. xcii.
1838. *Philonexis hyalinus*, d'Orb., Céph. acét., p. 104; Poulpes, pl. xvi. figs. 1–3.
1879. *Tremoctopus hyalinus*, Tryon, Man. Conch., vol. i. p. 131.

7 *Tremoctopus ocellatus*, Brock.

1882. *Tremoctopus ocellatus*, Brock, Zeitschr. f. wiss. Zool., Bd. xxxvi. p. 601, pl. xxxvii. figs. 1, 2.

8. *Tremoctopus semipalmatus* (Owen).

1836. *Octopus semipalmatus*, Owen, Trans. Zool. Soc. Lond., vol. ii. p. 112, pl. xxi. figs. 12, 13.

(Uncertain species.)

9. *Tremoctopus dubius* (Eydoux et Souleyet), Tryon.

1851. *Philonexis dubia*, Vér., Céph. médit., p. 34.
1852. *Octopus dubius*, E. et S., Voy. "Bonite," p. 15, pl. i. figs. 10-14.
1879. *Tremoctopus dubius*, Tryon, Man. Conch., vol. i. p. 131.

Family V. Alloposidæ, Verrill, 1881.

Alloposus, Verrill, 1880.

Haliphron (?), Steenstrup.

1. *Alloposus mollis*, Verrill (p. 72).

1859. *Haliphron atlanticus*, Stp., Vid. Meddel. nat. Foren. Kjobenhavn, Aar 1858, p. 183.
1880. *Alloposus mollis*, Vll., Amer. Journ. Sci. and Arts, vol. xx. p. 394.
1881. „ „ Vll., Ceph. N. E. Amer., pp. 366, 420, pls. l., li. figs. 3, 4.

Family VI. Octopodidæ, d'Orbigny, 1838.

Octopidæ, d'Orb. (*pars*).

Octopus, Lamarck, 1799.

1. *Octopus vulgaris*, Lamarck.

1799. *Octopus vulgaris*, Lmk., Mém. Soc. Hist. Nat. Paris, t. i. p. 18.
1826. „ *brevitentaculatus (?)*, Blv., Dict. d. Sci. Nat., t. xliii. p. 187.
1838. „ *vulgaris*, d'Orb., Céph. acét., p. 26, pls. ii., iii. *bis*; pl. viii. figs. 1, 2; pls. xi.–xv.; pl. xxix. fig. 6.
1851. „ „ Vér., Céph. médit., p. 16, pl. viii.
1869. „ *Troscheli (?)*, Targ., Cef. Mus. Firenze, p. 19.

2. *Octopus salutii*, Vérany.

1837. *Octopus Salutii*, Vér., Mem. Accad. Sci. Torino, p. 93, pl. iii.
1851. „ „ Vér., Céph. médit., p. 20, pl. ix.

3. *Octopus occidentalis*, Steenstrup., MS. (p. 77).

... *Octopus occidentalis*, Stp., MS. in Mus. Havn.
1853. „ *vulgaris*, var. *americanus*, d'Orb., Moll. Cuba, p. 14, tab. i.

4. *Octopus tuberculatus*, Blainville (p. 78).

1826. *Octopus tuberculatus*, Blv., Dict. d. Sci. Nat., t. xliii. p. 187.

5. *Octopus verrucosus*, Hoyle (Pl. IV.; p. 79).

1885. *Octopus verrucosus*, Hoyle, Diagnoses I., p. 222.

6. *Octopus granulatus*, Lamarck[1] (p. 80).

1792. *Sepia rugosa*, Bosc, Actes Soc. Hist. Nat. Paris, t. i. p. 24, pl. v. figs. 1, 2.
1799. *Octopus granulatus*, Lmk., Mém. Soc. Hist. Nat. Paris, t. i. p. 20.
1838. „ *rugosus*, d'Orb., Céph. acét., p. 45; Poulpes, pls. vi., xxiii. fig 2.
1869. „ *incertus*, Targ., Cef. Mus. Firenze, p. 22, tav. vi. figs. 9, 11.

7. *Octopus boscii* (Lesueur) (Pl. I., Pl. III. fig. 2; p. 81).

1821. *Sepia Boscii*, Les., Journ. Acad. Nat. Sci. Philad., vol. ii. p. 101.
1826. *Octopus variolatus*, Blv., Dict. d. Sci. Nat., t. xliii. p. 186.
1838. „ *Boscii*, d'Orb., Céph. acét., p. 68.
1849. „ „ Gray, B.M.C., p. 12.
1885. „ „ var. *pallida*, Hoyle, Diagnoses I., p. 223.

8. *Octopus tetricus*, Gould.

1852. *Octopus tetricus*, Gld., Moll. Wilkes Exped., p. 474, fig. 588.

9. *Octopus polyzenia*, Gray.

1849. *Octopus polyzenia*, Gray, B.M.C., p. 13.
1884. „ „ E. A. Sm., "Alert" Rep., p. 34, pl. iv. fig. A.

10. *Octopus tonganus*, Hoyle (Pl. VIII. figs. 1, 2; p. 83).

1885. *Octopus tonganus*, Hoyle, Diagnoses I., p. 225.

11. *Octopus de filippi*, Vérany.

1851. *Octopus De-Filippii*, Vér., Céph. médit., p. 30, pl. xi. figs. D, F
1869. „ *De Filippi*, Targ., Cef. Mus. Firenze, p. 20.

12. *Octopus vitiensis*, Hoyle (Pl. VII. figs. 6–8; p. 84).

1885. *Octopus vitiensis*, Hoyle, Diagnoses I., p. 226.

13. *Octopus bimaculatus*, Verrill.

1883. *Octopus bimaculatus*, Vll, "Blake" Suppl., p. 121, pl. v. fig. 1; pl. vi.

14. *Octopus marmoratus*, Hoyle (Pl. VI.; p. 85).

1885. *Octopus marmoratus*, Hoyle, Diagnoses I., p. 227.

15. *Octopus areolatus*, de Haan (Pl. III. figs. 6, 7; p. 86).

1835. *Octopus areolatus*, de Haan, MS. (*fide* d'Orb.).
1838. „ „ d'Orb., Céph. acét., p. 65.
1838. „ *sinensis* (?), d'Orb., Céph. acét., p. 68, pl. ix.
1849. „ *ocellatus*, Gray, B.M.C., p. 15.
1886. „ „ Appellöf, Japanska Ceph., p. 8, pl. i. figs. 1, 2, 3.

[1] I have preferred Lamarck's name to that of Bosc, which rests only on a very poor figure.

16. *Octopus superciliosus*, Quoy et Gaimard.

1832. *Octopus superciliosus*, Q. et G., Voy. "Astrolabe," t. ii. p. 88, pl. vi. fig. 4.
1838. „ „ d'Orb., Céph. acét., p. 41; Poulpes, pl. x. fig. 3, pl. xxviii. fig. 6.

17. *Octopus australis*, Hoyle (Pl. III. figs. 4, 5; p. 88).

1885. *Octopus australis*, Hoyle, Diagnoses I., p. 224.

18. *Octopus membranaceus*, Quoy et Gaimard.

1832. *Octopus membranaceus*, Q. et G., Voy. "Astrolabe," t. ii. p. 89, pl. vi. fig. 5.
1882. *Amphioctopus membranaceus*, Fischer, Man. de Conch., p. 333.

19. *Octopus carolinensis*, Verrill.

1884. *Octopus Carolinensis*, Vll., Second Catal., p. 235.
1885. „ „ Vll., Third Catal., pl. xlii. fig. 4.

20. *Octopus horridus*, d'Orbigny.

1826. *Octopus horridus*, d'Orb., Tabl. méth., Ann. d. Sci. Nat., t. vii. p. 144, No. 4.
1838. „ „ d'Orb., Céph. acét., p. 51; Poulpes, pl. vii. fig. 3.
1848. „ *argus*, Krauss, Südafrik. Moll., p. 132, pl. vi. fig. 26.

21. *Octopus aculeatus*, d'Orbigny.

1825. *Octopus aculeatus*, d'Orb., Céph. acét.; Poulpes, pl. vii. (*nomen tantum*).
1838. „ „ d'Orb., Céph. acét., p. 53; Poulpes, pl. vii. figs. 1, 2, pl. viii. fig. 1, pl. xxiii. figs. 3, 4.

22. *Octopus tenebricus*, E. A. Smith.

1884. *Octopus tenebricus*, E. A. Sm., "Alert" Rep., p. 35, pl. iv. fig. a.

23. *Octopus megalocyathus*, Gould.

1852. *Octopus megalocyathus*, Gld., Moll. Wilkes Exped., p. 471, fig. 586.

24. *Octopus fontanianus*, d'Orbigny.

1835. *Octopus fontanianus*, d'Orb., Amér. mérid., p. 28, pl. ii. fig. 5.
1838. „ „ d'Orb., Céph. acét., p. 49; Poulpes, pl. xxviii. fig. 5, pl. xxix. fig. 1.

25. *Octopus tehuelchus*, d'Orbigny (p. 89).

1835. *Octopus tehuelchus*, d'Orb., Amér. mérid., p. 27, pl. i. figs. 6, 7.
1838. „ „ d'Orb., Céph. acét., p. 55; Poulpes, pl. xvii. fig. 6.

26. *Octopus hawaiensis*, Eydoux et Souleyet.

1852. *Octopus hawaiensis*, E. et S., Voy. "Bonite," p. 9, pl. i. figs. 1–5.

27. *Octopus globosus*, Appellöf.

1886. *Octopus globosus*, Appellöf, Japanska Ceph., p. 7, pl. i. figs. 4, 5.

28. *Octopus duplex*, Hoyle (Pl. VII. fig. 5; p. 90).

1885. *Octopus duplex*, Hoyle, Diagnoses I., p. 226.

29. *Octopus lentus*, Verrill.

1880. *Octopus lentus*, Vll., Amer. Journ. Sci. and Arts, vol. xix. p. 138.
1881. „ „ Vll., Ceph. N. E. Amer., p. 375, pl. xxxv. figs. 1, 2; pl. li. fig. 2.

30. *Octopus obesus*, Verrill.

1880. *Octopus obesus*, Vll., Amer. Journ. Sci. and Arts, vol. xix. pp. 137, 294.
1881. „ „ Vll., Ceph. N. E. Amer., p. 379, pl. xxxvi. fig. 3.

31. *Octopus furvus*, Gould.

1852. *Octopus furvus*, Gld., Moll. Wilkes Exped., p. 475, fig. 589.

32. *Octopus piscatorum*, Verrill (p. 91).

1879. *Octopus piscatorum*, Vll., Amer. Journ. Sci. and Arts, vol. xviii. p. 470.
1881. „ „ Vll., Ceph. N. E. Amer., p. 377, pl. xxxvi. figs. 1, 2.
1885. „ „ Vll., Third Catal., pl. xlii. fig. 5.

33. *Octopus arcticus*, Prosch (p. 91).

1834. *Sepia grönlandica* (*?*), Dewh., Nat. Hist. Cetacea, p. 263.
1849. *Octopus arcticus*, Prosch, K. dansk. Vidensk. Selsk. Skriv., Rk. 5, Bd. i. p. 53, figs. 1–3.
1856. „ „ Stp., Hectocotyl., p. 201, Tav. ii. fig. 2.
1873. „ *Bairdii*, Vll., Amer. Journ. Sci. and Arts, vol. v. p. 5.
1878. „ „ Sars, Moll. Reg. Arct. Norv., p. 339, pl. xxxiii. figs. 1–10.
1881. „ „ Vll., Ceph. N. E. Amer., pp. 368, 421, pl. xxxiii. fig. 1; pl. xxxiv. figs. 5, 6; pl. xxxvi. fig. 10; pl. xxxviii. fig. 8; pl. xlix. fig. 4; pl. li. fig. 1.

34. *Octopus verrilli*, n. n.[1]

1883. *Octopus pictus*, Vll., "Blake" Suppl., p. 112, pl. iii. fig. 3.

35. *Octopus pictus*, Brock (Pl. VIII. fig. 3; p. 92).

1882. *Octopus pictus*, Brock, Zeitschr. f. wiss. Zool., Bd. xxxvi. p. 603, Taf. xxxvii. fig. 3.
1883. „ *maculosus*, Hoyle, Proc. Roy. Phys. Soc. Edin., vol. vii. p. 319, pl. vi.
1884. „ „ E. A. Sm., "Alert" Rep., p. 36, pl. iv. fig. c.

36. *Octopus lunulatus*, Quoy et Gaimard.

1832. *Octopus lunulatus*, Q. et G., Voy. "Astrolabe," t. ii. p. 86, pl. vi. figs. 1, 2.
1838. „ „ d'Orb., Céph. acét., p. 59; Poulpes, pl. x. fig. 2, pl. xxvi. figs. 5–7.

37. *Octopus aranea*, d'Orbigny.

1826. *Octopus aranea*, d'Orb., Céph. acét.; Poulpes, pl. v. (*nomen tantum*).
1838. „ „ d'Orb., Céph. acét., p. 57; Poulpes, pl. v.

[1] Verrill's name having been preoccupied by Brock, I take the liberty of re-naming the species after its original describer, who has made us acquainted with so many interesting Cephalopods.

38. *Octopus bermudensis*, Hoyle (Pl. II. fig. 5; p. 94).

1885. *Octopus bermudensis*, Hoyle, Diagnoses I., p. 228.

39. *Octopus macropus*, Risso[1] (p. 95).

1826. *Octopus macropus*, Risso, Hist. Nat. Eur. mérid., t. iv. p. 3.
1826. „ *Cuvierii*, d'Orb., Céph. acét.; Poulpes, pl. iv. (*nomen tantum*).
1838. „ *Cuvieri*, d'Orb., Céph. acét., p. 18; Poulpes, pls. i., iv., xxiv., xxvii.
1851. „ *macropus*, Vér., Céph. médit., p. 27, pl. x.
1869. „ „ Targ., Cef. Mus. Firenze, p. 23.
1869. „ *Cuvieri*, Targ., *Ibid.* p. 24.
1886. „ „ Appellöf, Japanska Céph., p. 6, pl. i. fig. 6.

40. *Octopus ornatus*, Gould.

1852. *Octopus ornatus*, Gld., Moll. Wilkes Exped., p. 476, fig. 590.

41. *Octopus gracilis*, Verrill.

1884. *Octopus gracilis*, Vll., Second Catal., p. 236.

42. *Octopus bandensis*, Hoyle (Pl. VII. figs. 9, 10; p. 96).

1885. *Octopus bandensis*, Hoyle, Diagnoses I., p. 227.

43. *Octopus januarii*, Steenstrup, MS. (Pl. VII. figs. 1–4; p. 97).

1885. *Octopus januarii*, Hoyle, Diagnoses I., p. 229.

44. *Octopus levis*, Hoyle (Pl. II. figs. 1–4; Pl. III. fig. 1; p. 98).

1885. *Octopus levis*, Hoyle, Diagnoses I., p. 229.

45. *Octopus punctatus*, Gabb (Pl. V.; p. 100).

1862. *Octopus punctatus*, Gabb, Proc. Calif. Acad., vol. ii. p. 170.
1883. „ „ Vll., "Blake" Suppl., p. 117, pl. iv.; pl. v. fig. 2.
1885. *Octopus honkongensis*, Hoyle, Diagnoses I., p. 224.

46. *Octopus filosus*, Howell.

1867. *Octopus filosa*, Howell, Amer. Journ. Conch., vol. iii. p. 240, pl. xiv.

47. *Octopus alderii*, Vérany.

1851. *Octopus Alderii*, Vér., Céph. médit., p. 32, pl. vii. *bis*, fig. 3.

(Species insufficiently characterised.)

48. *Octopus brevipes*, d'Orbigny.

1838. *Octopus brevipes*, d'Orb., Cépn. acet., p. 61; Poulpes, pl. xvii. fig. 1.

[1] I do not feel certain that this species and *Octopus cuvieri* are really the same. D'Orbigny places them together under the name *Octopus cuvieri*, and Vérany regards them as identical, but prefers the name *Octopus macropus*. Targioni-Tozzetti separates them, and Dr. Jatta unites them. Professor Steenstrup informs me that he is not convinced of their identity.

49. *Octopus capensis*, Eydoux et Souleyet.

1852. *Octopus capensis*, E. et S., Voy. "Bonite," p. 11, pl. i. figs. 6, 7.

50. *Octopus ægina*, Gray.

1849. *Octopus Ægina*, Gray, B.M.C., p. 7.

51. *Octopus cassiopea*, Gray.

1849. *Octopus Cassiopea*, Gray, B.M.C., p. 9.

52. *Octopus cephea*, Gray.

1849. *Octopus Cephea*, Gray, B.M.C., p. 15.

53. *Octopus cyanea*, Gray.

1849. *Octopus Cyanea*, Gray, B.M.C., p. 15.

54. *Octopus eudora*, Gray.

1849. *Octopus Eudora*, Gray, B.M.C., p. 9.

55. *Octopus favonia*, Gray.

1849. *Octopus favonia*, Gray, B.M.C., p. 9.

56. *Octopus geryonea*, Gray.

1849. *Octopus Geryonea*, Gray, B.M.C., p. 7.

57. *Octopus medoria*, Gray.

1849. *Octopus medoria*, Gray, B.M.C., p. 14.

58. *Octopus berenice*, Gray.

1849. *Octopus Berenice*, Gray, B.M.C., p. 11.

59. *Octopus saphenia*, Gray.

1849. *Octopus Saphenia*, Gray, B.M.C., p. 11.

60. *Octopus hardwickei*, Gray.

1849. *Octopus Hardwickei*, Gray, B.M.C., p. 8.

61. *Octopus pusillus*, Gould.

1852. *Octopus pusillus*, Gld., Moll. Wilkes Exped., p. 478, fig 591.

62. *Octopus mollis*, Gould.

1852. *Octopus mollis*, Gld., Moll. Wilkes Exped., p. 479, fig. 592.

63. *Octopus mimus*, Gould.

1852. *Octopus mimus*, Gld., Moll. Wilkes Exped., p. 473, fig. 587.

64. *Octopus maorum*, Hutton.

1880. *Octopus maorum*, Hutton, Manual N. Zeal. Moll., p. 1.
1882. „ „ Hutton, Trans. N. Zeal. Inst., vol. xiv. p. 162, pl. vi. fig. A (*dentition*).
1885. „ „ Parker, Nature, vol. xxxii. p. 586.

65. *Octopus communis*, Park.

1885. *Octopus communis*, Park, Trans. N. Zeal. Inst., vol. xvii. p. 198.

66. *Octopus harmandi*, de Rochebrune.

1882. *Octopus Harmandi*, Rochebr., Bull. soc. philom. Paris, sér. 7, t. vi. p. 73.

67. *Octopus pilosus*, Risso.

1826. *Octopus pilosus*, Risso, Hist. Nat. Eur. mérid., t. iv. p. 4.

68. *Octopus peronii* (Lesueur), d'Orbigny.

1821. *Sepia Peronii*, Les., Journ. Acad. Nat. Sci. Philad., vol. ii. p. 101.
1845. *Octopus Peronii*, d'Orb., Moll. viv., p. 185.

69. *Octopus longipes*, Leach.

1817. *Octopus longipes*, Leach, Zool. Miscell., vol. iii. p. 139.

70. *Octopus granosus*, Blainville.

1826. *Octopus granosus*, Blv., Dict. d. Sci. Nat., t. xliii. p. 186.

71. *Octopus fimbriatus*, Rüppell, MS.

1838. *Octopus fimbriatus*, d'Orb., Céph. acét., p. 64.

72. *Octopus fang-siao*, d'Orbigny.

1838. *Octopus fang-siao*, d'Orb., Céph. acét., p. 70.

73. *Octopus cærulescens*, Péron.

1826. *Octopus cærulescens*, Blv., Dict. d. Sci. Nat., t. xliii. p. 189.

74. *Octopus didynamus*, Rafinesque.

1814. *Octopus didynamus*, Raf., Précis découv. somiol., p. 28.

75. *Octopus tetradynamus*, Rafinesque.

1814. *Octopus tetradynamus*, Raf., Précis découv. somiol., p. 28.

76. *Octopus frayedus*, Rafinesque.

1814. *Octopus frayedus*, Raf., Précis découv. somiol., p. 28.

77. *Octopus heteropus*, Rafinesque.

Octopus heteropus, Raf., Précis découv. somiol., p. 28.

Subgenus *Tritaxeopus*, Owen, 1881.

78. *Octopus cornutus* (Owen).

1881. *Tritaxeopus cornutus*, Owen, Trans. Zool. Soc. Lond., vol. xi., part 5, p. 131, pl. xxiii.

Pinnoctopus, d'Orbigny, 1845.

1. *Pinnoctopus cordiformis* (Quoy et Gaimard), d'Orbigny.

1832. *Octopus cordiformis*, Q. et G., Voy. "Astrolabe," t. ii. p. 87, pl. vi. fig. 3.
1845. *Pinnoctopus cordiformis*, d'Orb., Moll. viv., p. 193, pl. ii.

Cistopus, Gray, 1849.

1. *Cistopus indicus* (Rapp, MS.), Gray.[1]

1838. *Octopus indicus*, d'Orb., Céph. acét., p. 24; Poulpes, pl. xxv., pl. xxvi. figs. 1–4.
1849. *Cistopus indicus*, Gray, B.M.C., p. 20.

Scæurgus, Troschel, 1857.

1. *Scæurgus titanotus*, Troschel.

1857. *Scæurgus titanotus*, Trosch., Archiv f. Naturgesch., Jahrg. xxiii. Bd. i. p. 51, Taf. iv. figs. 4, 5.
1858. „ „ Trosch., *Op. cit.*, Jahrg. xxiv. Bd. i. p. 298.

2. *Scæurgus unicirrhus* (delle Chiaje, MS.), Tiberi.[2]

1838. *Octopus unicirrhus*, d'Orb., Céph. acét., p. 70.
1851. „ *Cocco*, Vér., Céph. médit., p. 22, pls. xii., xii. *bis*.
1857. *Scæurgus Cocco*, Trosch., Archiv f. Naturgesch., Jahrg. xxiii. Bd. i. p. 57, Taf. iv. fig. 6.
1880. „ *unicirrhus*, Tiberi, Bull. soc. mal. ital., vol. vi. p. 12.

3. *Scæurgus tetracirrhus* (delle Chiaje, MS.), Tiberi.

1838. *Octopus tetracirrhus*, d'Orb., Céph. acét., p. 36; Poulpes, pl. xxii.
1851. „ „ Vér., Céph. médit., p. 25, pl. vii. *bis*, figs. 1, 2.
1880. *Scæurgus tetracirrhus*, Tiberi, Bull. mal. ital., vol. iv. p. 12.
1882. *Pteroctopus tetracirrhus*, Fischer, Man. de Conch., p. 334.

[1] Just at the time of going to press Professor Steenstrup writes me that it is, in his opinion, very doubtful whether d'Orbigny's two figures represent the same species. He is disposed to regard the type of Rapp's species as having been a true *Octopus*, and for the form with pouches between the arms he has adopted the name *Cistopus bursarius*.

[2] Vérany (*loc. cit.*, p. 24) admits that his *Octopus cocco* is identical with delle Chiaje's *Octopus unicirrhus*, and also recognises the priority of the latter, under which circumstances there can be no doubt that the name has been rightly restored by Dr. Tiberi. D'Orbigny regarded it as a synonym of *Octopus vulgaris*.

Eledone, Leach, 1817.

Ozoena, Rafinesque.

1. *Eledone moschata* (Lamarck), Leach.

1799. *Octopus moschatus*, Lmk., Mém. Soc. Hist. Nat. Paris, t. i. p. 22, pl. ii.
1817. *Eledone moschata*, Leach, Zool. Miscell., vol. iii. p. 138.
1838. „ „ d'Orb., Céph. acét., p. 72; Elédons, pls. i., i. *bis*, pl. iii.
1851. „ *moschatus*, Vér., Céph. médit., p. 7, pls. iv.–vi.

2. *Eledone cirrosa* (Lamarck), d'Orbigny (p. 102).

1776. *Sepia octopodia* (?), Pennant, Brit. Zool., vol. iv. p. 53, pl. xxviii. fig. 44.
1799. *Octopus cirrhosus*, Lmk., Mém. Soc. Hist. Nat. Paris, t. i. p. 21, pl. i. fig. 2.
1814. *Ozoena Aldrovandi*, Raf., Précis découv. somiol., p. 29.
1827. *Octopus ventricosus*, Grant, Edin. N. Phil. Journ., p. 309.
1838. *Eledone cirrhosus*, d'Orb., Céph. acét., p. 79; Elédons, pl. ii.
1843. „ *Pennantii*, Macgillivray, Moll. Anim. Scot., p. 31.
1843. „ *Aldrovandi*, Macgillivray, *Ibid.*, p. 32.
1851. „ *Aldrovandi*, Vér., Céph. médit., p. 12, pls. ii., iii.
1851. „ *Genei*, Vér., *Op. cit.*, p. 15, pl. i.

3. *Eledone verrucosa*, Verrill (p. 104).

1881. *Eledone verrucosa*, Vll., "Blake" Rep., p. 105, pls. v., vi.
1881. „ „ Vll., Ceph. N. E. Amer., p. 380, pls. lii., liii.

4. *Eledone rotunda*, Hoyle (Pl. VIII. figs. 4–6; p. 104).

1885. *Eledone rotunda*, Hoyle, Diagnoses I., p. 230.

5. *Eledone brevis*, Hoyle (Pl. VIII. fig. 7; p. 105).

1885. *Eledone brevis*, Hoyle, Diagnoses I., p. 230.

6. *Eledone halliana*, de Rochebrune.

1884. *Eledona halliana*, Rochebr., Monogr. Eledonidæ, p. 162.

Hoylea, de Rochebrune, 1886.

Hallia, Val., MS.

1. *Hoylea sepioidea* (Valenciennes, MS.) de Rochebrune.

1884. *Hallia sepioidea*, Rochebr., Monogr. Eledonidæ, p. 156, pl. vii.
1886. *Hoylea sepioidea*, Rochebr., Bull. soc. philom. Paris, sér. 7, t. ix. p. 85.

Eledonenta, de Rochebrune, 1884.

1. *Eledonenta filholiana*, de Rochebrune.

1884. *Eledonenta Filholiana*, Rochebr., Monogr. Eledonidæ, p. 157.

2. *Eledonenta microsicya*, de Rochebrune.

1884. *Eledonenta microsicya*, Rochebr., Monogr. Eledonidæ, p. 158.

Eledonella, Verrill, 1884.

Japetella, Hoyle (*pars*).

1. *Eledonella pygmæa*, Verrill.

1884. *Eledonella pygmæa*, Vll., Second Catal., p. 145, pl. xxxii. fig. 2.

2. *Eledonella diaphana*, Hoyle (Pl. IX. figs. 3–6; p. 107).

1885. *Japetella diaphana*, Hoyle, Diagnoses I., p. 232.

Japetella, Hoyle, 1885.

1. *Japetella prismatica*, Hoyle (Pl. IX. figs. 1, 2; p. 109).

1885. *Japetella prismatica*, Hoyle, Diagnoses I., p. 231.

Bolitæna, Steenstrup, 1859.

1. *Bolitæna microcotyla*, Steenstrup, MS.[1]

1859. *Bolitæna* sp., Stp., Vid. Meddel. nat. Foren. Kjøbenhavn, Aar 1858, p. 183.

Suborder II. DECAPODA, Leach, 1818.

Division I. MYOPSIDA, d'Orbigny, 1845.

Family VII. Sepiolini, Steenstrup, 1861.

Sepiola (Rondelet, 1554), Leach, 1817.

1. *Sepiola rondeleti*, Leach (p. 110).

1558. *Sepiola Rondeleti*, Gesner, De Aquat., lib. iv. p. 855.
1817. „ *Rondeletii*, Leach, Zool. Miscell., vol. iii. p. 140.
1839. „ „ d'Orb., Céph. acét., p. 230; Sépioles, pl. *i.* figs. 1–6, pl. ii. figs. 3–13, pl. iii. figs. 6–9.
1845. „ *oceanica*, d'Orb., Moll. viv., pl. x. fig. 13 (*err.*).
1869. „ *major* (*?*), Targ., Cef. Mus. Firenze, p. 45.

[1] *Bolitæna microcotyla* has a soft ovoid body of gelatinous consistency, and a reddish-purple colour, somewhat resembling *Cirroteuthis*, but destitute of fins and with the mantle-opening very wide, extending beyond the eyes instead of being a narrow aperture immediately surrounding the funnel. The arms are comparatively short and slender, webbed almost up to the extremities, and provided with a single row of very small suckers. The jaws are very little curved, and the radula is remarkable in that the rows of teeth present a serial repetition, the fifth resembling the first.

2. *Sepiola oweniana*, d'Orbigny.

1839. *Sepiola Oweniana*, d'Orb., Céph. acét., p. 229; Sépioles, pl. iii. figs. 1–5.
1867. „ „ (?) Mörch, Vid. Meddel. nat. Foren. Kjøbenhavn, p. 101.
1879. „ „ (?) Tryon, Man. Conch., vol. i. p. 156 (*habitat*).

3. *Sepiola pacifica*, Kirk.

1882. *Sepiola pacifica*, Kirk, Trans. N. Zeal. Inst., vol. xiv. p. 283.

4. *Sepiola atlantica*, d'Orbigny.

1839. *Sepiola atlantica*, d'Orb., Céph. acét., p. 235; Sépioles, pl. iv. figs. 1–12.

5. *Sepiola stenodactyla*, Grant.

1833. *Sepiola stenodactyla*, Grant, Trans. Zool. Soc. Lond., vol. i. p. 84, pl. ii. figs. 1, 2.

6. *Sepiola pusilla*, Pfeffer.[1]

1884. *Sepiola pusilla*, Pffr., Ceph. Hamb. Mus., p. 7, fig. 9.

7. *Sepiola schneehageni*, Pfeffer.[1]

1884. *Sepiola Schneehageni*, Pffr., Ceph. Hamb. Mus., p. 7, fig. 8.

8. *Sepiola tasmanica*, Pfeffer.[1]

1884. *Sepiola tasmanica*, Pffr., Ceph. Hamb. Mus., p. 6., fig. 7.

9. *Sepiola rossiæformis*, Pfeffer.

1884. *Sepiola rossiæformis*, Pffr., Ceph. Hamb. Mus., p. 8, fig. 10.

10. *Sepiola penares* (Gray), Tryon.

1849. *Fidenas penares*, Gray, B.M.C., p. 95.
1858. „ „ Adams, Gen. Rec. Moll., p. 41, pl. v. fig. 1.
1879. *Sepiola penares*, Tryon, Man. Conch., vol. i. p. 157.

Inioteuthis, Verrill, 1881.

1. *Inioteuthis japonica* (Tilesius, MS.), Verrill.

1839. *Sepiola Japonica*, d'Orb., Céph. acét., p. 234.
1881. *Inioteuthis Japonica*, Vll., Ceph. N. E. Amer., p. 417.

2. *Inioteuthis morsei*, Verrill (Pl. XIV. figs. 1–9; p. 112).

1881. *Inioteuthis Morsei*, Vll., Ceph. N. E. Amer., p. 417.
1884. *Sepiola bursa* (?), Pffr., Ceph. Hamb. Mus., p. 6, fig. 6.
1886. *Inioteuthis Morsei*, Appellöf, Japanska Ceph., p. 15, pl. ii. figs. 15, 16; pl. iii. figs. 16, 19, 20, 23.

[1] From the absence of the pen in these three species, I am inclined to suspect that some of them should be referred to Verrill's genus *Inioteuthis*; possibly the same is the case with *Sepiola stenodactyla* (see p. 114).

Stoloteuthis, Verrill, 1881.

1. *Stoloteuthis leucoptera*, Verrill.

1878. *Sepiola leucoptera*, Vll., Amer. Journ. Sci. and Arts, vol. xvi. p. 378.
1881. *Stoloteuthis leucoptera*, Vll., Ceph. N. E. Amer., pp. 347, 418, pl. xxxi. figs. 4, 5; pl. liv. fig. 4.

Nectoteuthis, Verrill, 1883.

1. *Nectoteuthis pourtalesii*, Verrill.

1883. *Nectoteuthis Pourtalesii*, Vll., "Blake" Suppl., p. 108, pl. iii. fig. 1.

Rossia, Owen, 1834.

1. *Rossia palpebrosa*, Owen.

1834. *Rossia palpebrosa*, Owen, Ross' Second Arctic Voy., Nat. Hist., p. 93. pl. b, fig. 1; pl. c.

2. *Rossia macrosoma* (delle Chiaje), d'Orbigny.

1829. *Sepiola macrosoma*, d. Ch., Mem. stor. anim., t. lxxi. (*fide* Gerv. et v. Ben.).
1839. „ „ Gerv. et v. Ben., Bull. Acad. Sci. Bruxelles, t. vi. p. 39.
1839. *Rossia macrosoma*, d'Orb., Céph. acét., p. 245; Sépioles, pl. iv. figs. 13–24.
1869. „ *Panceri*, Targ., Cef. Mus. Firenze, p. 46, pl. vii. fig. 7 (♂).

3. *Rossia oweni*, Ball (Pl. XV. figs. 1–9; p. 114).

1842. *Rossia Owenii*, Ball, Proc. Roy. Irish Acad., vol. ii. p. 193 (♂).
1842. „ *Jacobi*, Ball, *Op. cit.*, p. 193 (♀).
1845. „ *Owenii*, Lovén, Öfversigt k. Vetensk.-Akad. Förhandl., p. 121.
1853. „ „ Forbes and Hanley, Brit. Moll., vol. iv. p. 223, pl. sss, fig. 1.

4. *Rossia glaucopis*, Lovén (p. 116).

1845. *Rossia glaucopis*, Lovén, Öfversigt. k. Vetensk.-Akad. Förhandl., p. 121.
1869. „ *papillifera*, Jeffreys, Brit. Conch., vol. v. p. 134.
1878. „ *glaucopis*, Sars, Moll. Reg. Arct. Norv., p. 337, pl. xxxii.

5. *Rossia hyatti*, Verrill.

1878. *Rossia Hyatti*, Vll., Amer. Journ. Sci. and Arts, vol. xvi. p. 208.
1881. „ „ Vll., Ceph. N. E. Amer., p. 351, pl. xxvii. figs. 8, 9; pl. xxx. fig. 1; pl. xxxi. figs. 1, 2; pl. xlvi. fig. 5.

6. *Rossia sublevis*, Verrill (p. 117).

1878. *Rossia sublævis*, Vll., Amer. Journ. Sci. and Arts, vol. xvi. p. 209.
1881. „ *sublevis*, Vll., Ceph. N. E. Amer., pp. 354, 419, pl. xxx. fig. 2; pl. xxxi. fig. 3; pl. xlvi. fig. 4; pl. xlvii. figs. 2–4.

7. *Rossia brachyura*, Verrill.

1883. *Rossia brachyura*, Vll., "Blake" Suppl., p. 110, pl. iii. fig. 2.

8. *Rossia mölleri*, Steenstrup.

1856. *Rossia Mölleri*, Stp., Hectocotyl., p. 198, pl. ii. fig. 1.

9. *Rossia tenera* (Verrill) (p. 118).

1880. *Heteroteuthis tenera*, Vll., Amer. Journ. Sci. and Arts., vol. xx. p. 392.
1881. „ „ Vll., Ceph. N. E. Amer., p. 357, pl. xlvi. figs. 2, 3; pl. xlvii. fig. 5.
1883. „ „ Vll., "Blake" Suppl., p. 111.

10. *Rossia patagonica*, E. A. Smith (Pl. XV. figs. 10–18 ; p. 119).

1881. *Rossia patagonica*, E. A. Sm., Proc. Zool. Soc. Lond., p. 22, pl. iii. fig. 3.

11. *Rossia megaptera*, Verrill.

1881. *Rossia megaptera*, Vll., Ceph. N. E. Amer., p. 349, pl. xxxviii. fig. 1; pl. xlvi. fig. 6.

Heteroteuthis, Gray, 1849 (*non* Verrill).

Rossia, Vérany et Auctt. (*pars*).

1. *Heteroteuthis dispar* (Rüppell), Gray.

1845. *Sepiola dispar*, Rüpp., Giorn. Gab. Messina, t. xxvi (*fide* Vér.)
1849. *Rossia* (*Heteroteuthis*) *dispar*, Gray, B.M.C., p. 90.
1851. „ *dispar*, Vér., Céph. médit., p. 63, pl. xxiii. figs. *d–h*.
1857. „ „ Trosch., Archiv f. Naturgesch., Jahrg. xxiii. Bd. i. p. 62, pl. iv. figs. 7, 8.
1858. „ „ Claus, *Op. cit.*, Jahrg. xxiv. Bd. i. p. 259, Taf. x. fig. 5.

Promachoteuthis, Hoyle, 1885.

1. *Promachoteuthis megaptera*, Hoyle (Pl. XIV. figs. 10–14 ; p. 120).

1885. *Promachoteuthis megaptera*, Hoyle, Narr. Chall. Exp., vol. i. p. 273, fig. 109.
1885. „ „ Hoyle, Diagnoses II., p. 182.

Family VIII. Sepiarii, Steenstrup, 1861.

Sepidæ, d'Orb. (*pars*).

Subfamily, Sepiadarii, Steenstrup, 1881.

Sepioloidea, d'Orbigny, 1839.

1. *Sepioloidea lineolata* (Quoy et Gaimard), d'Orbigny.

1832. *Sepiola lineolata*, Q. et G., Voy. "Astrolabe," t. ii. p. 82, pl. v. figs. 8–13.
1839. *Sepioloidea lineata*, d'Orb., Céph. acét., p. 240; Sépioles, pl. iii. figs. 10–18.
1881. „ „ Stp., Sepiadarium og Idiosepius, p. 233.
1884. „ „ Brock, Zeitschr. f. Wiss. Zool., Bd. xl. pp. 105–120.

Sepiadarium, Steenstrup, 1881.

1. *Sepiadarium kochii*, Steenstrup.

1881. *Sepiadarium Kochii*, Stp., Sepiadarium og Idiosepius, p. 214, pl. i. figs. 1–10.

Subfamily Idiosepii, Steenstrup, 1881.

Idiosepius, Steenstrup, 1881.

1. *Idiosepius pygmæus*, Steenstrup.[1]

1881. *Idiosepius pygmæus*, Stp., Sepiadarium og Idiosepius, p. 219, pl. i. figs. 11–22.

Spirula, Lamarck, 1801.

1. *Spirula peronii*, Lamarck (p. 122).

1822. *Spirula Peronii*, Lmk., Anim. s. vert., t. vii. p. 601.

Subfamily Eusepii, Steenstrup, 1881.

Sepia, Linné, 1766.

Rhombosepion, *Lophosepion*, *Spathidosepion*, *Doratosepion*, *Ascarosepion*, *Acanthosepion*, } de Rochebrune.[2][3]

1. *Sepia officinalis*, Linné.

1761. *Sepia officinalis*, Linn., Fauna Suecica, No. 2106.
1839. „ „ d'Orb., Céph. acét., p. 260; Seiches, pl. i., pl. ii. figs. 4, 5, pl. iii. figs. 1–3, pl. xvii. figs. 1, 2.

2. *Sepia filliouxii*, Lafont.

1839. *Sepia officinalis*, d'Orb., Céph. acét.,; Seiches, pl. ii. figs. 1, 2, 3.
1851. „ „ Vér., Céph. médit., pl. xxv.
1868. „ *Filliouxii*, Lafont, Bull. Assoc. Sci. Franc., No. 81 (*fide* Laf.).
1869. „ „ Lafont, Journ. de Conch., sér. 3, t. ix. p. 11.

[1] Steenstrup (*op. cit.*, p. 224) suggests the possibility that *Cranchia minima*, Fér., and *Loligopsis peronii*, Lmk., may be allied to this form.

[2] There are great differences of opinion as to the number of species that should be referred to this genus, and there seems to be as little agreement regarding the names which they should bear; *under* these circumstances I refrain from giving any opinion, but content myself with placing one species on the list, and using the name adopted by Prof. Huxley in his Report on the genus to be published in the present series.

[3] Dr. de Rochebrune has recently published a memoir (*Bull. Soc. philom. Paris*, sér. 7, t. viii. pp. 74–122, pls. iii.–vi.) in which he has divided the *Sepia* of previous authors into a number of new genera; most of these seem to me to be at most of subgeneric value, and there are so many points in which I find myself unable to follow Dr. de Rochebrune that I have only given references to his paper in the case of his new species.

3. *Sepia myrsus*, Gray.

1849. *Sepia myrsus*, Gray, B.M.C., p. 108.

4. *Sepia fischeri*, Lafont.

1871. *Sepia fischeri*, Lafont, Actes Linn. Soc. Bordeaux, t. xxviii. p. 271.

5. *Sepia hierredda*, Rang.

1837. *Sepia hierredda*, Rang, Mag. de Zool., ann. vii., cl. v. p. 75, pl. c.
1839. „ *Hierredda*, d'Orb., Céph. acét., p. 268 ; Seiches, pls. xiii., xviii.
1875. „ *hieredda*, Stp., Hemisepius, p. 478, pl. ii. fig. 2.

6. *Sepia vicellius*, Gray.

1849. *Sepia Vicellius*, Gray, B.M.C., p. 100.

7. *Sepia savignyi*, Blainville.

1827. *Sepia officinalis*, Aud., Expl. pl. Hist. Nat. Egypte, pl. v.; pl. i. fig. 3 (*fide* d'Orb.).
1827. „ *Savignyi*, Blv., Dict. d. Sci. Nat., t. xlviii. p. 285.
1839. „ „ d'Orb., Céph. acét., p. 268 ; Seiches, pls. xiii., xviii.

8. *Sepia smithi*, Hoyle (Pl. XVI. figs. 1–12 ; p. 124).

1885. *Sepia Smithi*, Hoyle, Diagnoses II., p. 190.

9. *Sepia papuensis*, Hoyle (Pl. XVI. figs. 13–23 ; p. 126).

1885. *Sepia papuensis*, Hoyle, Diagnoses II., p. 197.

10. *Sepia pagenstecheri*, Pfeffer.

1884. *Sepia Pagenstecheri*, Pfr., Ceph. Hamb. Mus., p. 9, fig. 12.

11. *Sepia plangon*, Gray.

1849. *Sepia plangon*, Gray, B.M.C., p. 104.

12. *Sepia singaporensis*, Pfeffer.

1884. *Sepia singaporensis*, Pfr., Ceph. Hamb. Mus., p. 10, fig. 13.

13. *Sepia polynesica*, Pfeffer.

1884. *Sepia polynesica*, Pfr., Ceph. Hamb. Mus., p. 11, fig. 14.

14. *Sepia bertheloti*, d'Orbigny.

1839. *Sepia Bertheloti*, d'Orb., Moll. Canaries, p. 21.
1839. „ „ d'Orb., Céph. acét., p. 214 ; Seiches, pls. xi., xxiii.

15. *Sepia verreauxi* (de Rochebrune).

1884. *Ascarosepion Verreauxi*, Rochebr., Monogr. Sepiadæ, p. 98.

16. *Sepia vermiculata*, Quoy et Gaimard.

1832. *Sepia vermiculata*, Q. et G., Voy. "Astrolabe," t. ii. p. 64, pl. i. figs. 1–5.
1839. „ „ d'Orb., Céph. acét., p. 279; Seiches, pl. iii. *bis*.

17. *Sepia latimanus*, Quoy et Gaimard.

1832. *Sepia latimanus*, Q. et G., Voy. "Astrolabe," t. ii. p. 68, pl. ii. figs. 2–11.
1839. „ „ d'Orb., Céph. acét., p. 283; Seiches, pl. xii. figs. 1–6, pl. xvii. figs. 16, 17.

18. *Sepia esculenta*, Hoyle (Pl. XVII. figs. 1–5; Pl. XVIII. figs. 1–6; p. 129).

1885. *Sepia esculenta*, Hoyle, Diagnoses II., p. 188.

19. *Sepia aculeata*, van Hasselt, MS.

1839. *Sepia aculeata*, d'Orb., Céph. acét., p. 287; Seiches, pl. v. *bis*; pl. xxv.
1875. „ „ Stp., Hemisepius, pl. ii. fig. 4.
1884. *Acanthosepion Hasselti*, Rochebr., Monogr. Sepiadæ, p. 101.

20. *Sepia indica*, d'Orbigny.

1839. *Sepia indica*, d'Orb., Céph. acét., p. 288; Seiches, pl. xxi. (*nomine Sepia Blainvillei*).

21. *Sepia zanzibarica*, Pfeffer.

1884. *Sepia zanzibarica*, Pffr., Ceph. Hamb. Mus., p. 9, fig. 11.

22. *Sepia rostrata*, d'Orbigny.

1839. *Sepia rostrata*, d'Orb., Céph. acét., p. 284; Seiches, pl. viii. fig. 6, pl. xxvi.
1884. *Acanthosepion spinigerum*, Rochebr., Monogr. Sepiadæ, p. 103.

23. *Sepia rouxii*, d'Orbigny.

1831. *Sepia Pharaonis* (*l*), Ehrbg., Symb. Phys., An. Moll. Ceph., Sep. No. I.
1839. „ *Rouxii*, d'Orb., Céph. acét., p. 271; Seiches, pl. xix.

24. *Sepia elliptica*, Hoyle (Pl. XIX. figs. 14 24; p. 131).

1885. *Sepia elliptica*, Hoyle, Diagnoses II., p. 189.

25. *Sepia brevimana*, Steenstrup.

1875. *Sepia brevimana*, Stp., Hemisepius, pp. 475, 479.

26. *Sepia australis*, d'Orbigny.

1839. *Sepia australis*, d'Orb., Céph. acét., p. 285; Seiches, pl. vii. fig. 4.

27. *Sepia venusta*, Pfeffer.

1884. *Sepia venusta*, Pffr., Ceph. Hamb. Mus., p. 12, fig. 15.

28. *Sepia orbignyana*, Férussac.

1826. *Sepia Orbigniana*, d'Orb., Tabl. méth., Ann. d. Sci. Nat. t. vii. p. 156.
1839. „ *Orbignyana*, d'Orb., Céph. acét., p. 273; Seiches, pl. v. figs. 1, 2.

29. *Sepia mestus*, Gray.

1849. *Sepia mestus*, Gray, B.M.C., p. 108.

30. *Sepia cultrata*, Steenstrup, MS. (Pl. XX.; p. 133).

1885. *Sepia cultrata*, Hoyle, Diagnoses II., p. 198.

31. *Sepia trygonina* (de Rochebrune).

1884. *Doratosepion trygoninum*, Rochebr., Monogr. Sepiadæ, p. 97.

32. *Sepia recurvirostra*, Steenstrup (p. 137).

1875. *Sepia recurvirostra*, Stp., Hemisepius, pp. 475, 479.

33. *Sepia sulcata*, Hoyle (Pl. XIX. figs. 1–13; p. 137).

1885. *Sepia sulcata*, Hoyle, Diagnoses II., p. 192.

34. *Sepia andreana*, Steenstrup.

1875. *Sepia andreana*, Stp., Hemisepius, pp. 474, 479, pl. i. figs. 11–19.

35. *Sepia andreanoides*, Hoyle (Pl. XXI. figs. 11–19; Pl. XXII. fig. 11; p. 139).

1885. *Sepia andreanoides*, Hoyle, Diagnoses II., p. 193.

36. *Sepia peterseni*, Appellöf.

1886. *Sepia Peterseni*, Appellöf, Japanska Ceph., p. 23, pl. ii. figs. 1–6; pl. iii. fig. 21.

37. *Sepia kiensis*, Hoyle (Pl. XVII. figs. 6–11; p. 141).

1885. *Sepia kiensis*, Hoyle, Diagnoses II., p. 194.

38. *Sepia kobiensis*, Hoyle (Pl. XVIII. figs. 7–14; p. 142).

1885. *Sepia kobiensis*, Hoyle, Diagnoses II., p. 195.

39. *Sepia capensis*, d'Orbigny.

1826. *Sepia capensis*, d'Orb., Céph. acét.; Seiches, pl. vii. figs. 1–3.
1832. „ *australis*, Q. et G., Voy. "Astrolabe," t. ii. p. 70, pl. v. figs. 3, 7.
1839. „ *capensis*, d'Orb., Céph. acét., p. 278; Seiches, pl. vii. figs. 1–3, pl. xii. figs. 7–11, pl. xvii. figs. 18, 19.
1849. „ *Sinope* (?), Gray, B.M.C., p. 106.

40. *Sepia elongata*, d'Orbigny.

1839. *Sepia elongata*, d'Orb., Céph. acét., p. 283; Seiches, pl. xxiv. figs. 7–10.

41. *Sepia elegans*, d'Orbigny.

1839. *Sepia elegans*, d'Orb., Céph. acét., p. 280; Seiches, pl. viii. figs. 1–5, pl. xxvii. figs. 3–6.

42. *Sepia ruppellaria*, d'Orbigny.

1839. *Sepia Rupellaria*, d'Orb., Céph. acét., p. 275; Seiches, pl. iii. figs. 10–13.
1851. „ *bisserialis*, Vér., Céph. médit., p. 73, pl. xxvi. figs. F, K.
1869. „ *rupellaria*, Fischer, Actes Linn. Soc. Bordeaux, t. xxvii. p. 125.

43. *Sepia lefebrei*, d'Orbigny.

1839. *Sepia Lefebrei*, d'Orb., Céph. acét., p. 282; Seiches, pl. xxiv. figs. 1–6.

44. *Sepia palmata*, Owen.

1881. *Sepia palmata*, Owen, Trans. Zool. Soc. Lond., vol. xi. part 5, p. 134, pls. xxiv., xxv.

45. *Sepia apama*, Gray.

1849. *Sepia apama*, Gray, B.M.C., p. 103.

46. *Sepia tuberculata*, Lamarck.

1799. *Sepia tuberculata*, Lmk., Mém. Soc. Hist. Nat. Paris, t. i. p. 9, pl. i. fig. 1.
1832. „ *papillata*, Q. et G., Voy. "Astrolabe," t. ii. p. 61, pl. i. figs. 6–14.
1875. „ *tuberculata*, Stp., Hemisepius, pp. 474, 479, pl. i. figs. 20, 21; pl. ii. fig. 6.

Subgenus *Metasepia*, Hoyle, 1885.

47. *Sepia* (*Metasepia*) *pfefferi*, Hoyle (Pl. XXI. figs. 1–10; p. 145).

1885. *Sepia* (*Metasepia*) *Pfefferi*, Hoyle, Diagnoses II., p. 199.

48. *Sepia* (*Metasepia*) *tullbergi*, Appellöf.

1886. *Sepia Tullbergi*, Appellöf, Japanska Ceph., p. 26, pl. ii. figs. 7–14.

(Species insufficiently characterised.)

49. *Sepia gibbosa*, Ehrenberg.

1831. *Sepia gibbosa*, Ehrbg., Symb. phys., Anim. Moll. Ceph., Sep., No. 2.
1869. „ „ Issel, Malacol. Mar Rosso, p. 238, pl. ii. figs. 14, 15.

50. *Sepia lycidas*, Gray.

1849. *Sepia Lycidas*, Gray, B.M.C., p. 103.

51. *Sepia brachycheira*, Tapparone-Canefri.

1877. *Sepia brachycheira*, Tapp.-Can., Ann. Mus. civ. Genova, vol. ix. p. 278

52. *Sepia jousseaumi*, de Rochebrune.

1884. *Sepia Jousseaumi*, Rochebr., Monogr. Sepiadæ, p. 117.

53. *Sepia mozambica*, de Rochebrune.

1884. *Sepia Mozambica*, Rochebr., Monogr. Sepiadæ, p. 118.

54. *Sepia javanica* (de Rochebrune).

1884. *Acanthosepion Javanicum*, Rochebr., Monogr. Sepiadæ, p. 110.

55. *Sepia goreensis* (de Rochebrune).

1884. *Acanthosepion Goreense*, Rochebr., Monogr. Sepiadæ, p. 109.

56. *Sepia enoplon* (de Rochebrune).

1884. *Acanthosepion enoplon*, Rochebr., Monogr. Sepiadæ, p. 108.

57. *Sepia oculifera* (de Rochebrune).

1884. *Acanthosepion oculiferum*, Rochebr., Monogr. Sepiadæ, p. 107.

58. *Sepia antillarum*, d'Orbigny.

1838. *Sepia antillarum*, d'Orb., Moll. Cuba, t. i. p. 33.
1845. „ „ d'Orb., Moll. viv., p. 300.

Sepiella, Gray, 1849; Steenstrup, 1880.

Sepia, Auctt. (*pars*).

1. *Sepiella inermis* (van Hasselt, MS.), Steenstrup.

1839. *Sepia inermis*, d'Orb., Céph. acét., p. 286; Seiches, pl. vi. *bis* (= ♂), pl. xx. figs. 1–9 (= ♀).
1839. „ *sinensis*, d'Orb., Céph. acét., p. 289; Seiches, pl. ix. figs. 1, 2 (*fide* Gray).
1849. „ *microcheirus*, Gray, B.M.C., p. 107.
1875. „ *inermis*, Stp., Hemisepius, p. 478, pl. ii. fig. 3.
1880. *Sepiella inermis*, Stp., Sepiella, pp. 347–356, figs. 1–8.

2. *Sepiella ornata* (Rang), Steenstrup.

1837. *Sepia ornata*, Rang., Mag. de Zool., ann. vii., cl. v. p. 76, pl. ci.
1839. „ „ d'Orb., Céph. acét., p. 276; Seiches, pl. xxii.
1849. „ „ Gray, B.M.C., p. 106.
1880. *Sepiella ornata*, Stp., Sepiella, pp. 347–356.

3. *Sepiella curta*, Pfeffer.

1884. *Sepiella curta*, Pffr., Ceph. Hamb. Mus., p. 13, fig. 16.

4. *Sepiella ocellata*, Pfeffer.

1884. *Sepiella ocellata*, Pffr., Ceph. Hamb. Mus., p. 13, fig. 17.

5. *Sepiella ovata*, Pfeffer.

1884. *Sepiella ovata*, Pffr., Ceph. Hamb. Mus., p. 14, fig. 18.

6. *Sepiella obtusata*, Pfeffer.

1884. *Sepiella obtusata*, Pfr., Ceph. Hamb. Mus., p. 15, fig. 19.

7. *Sepiella tourrannensis* (Eydoux et Souleyet).

1852. *Sepia tourrannensis*, E. et S., Voy. "Bonite," p. 33, pl. iii. figs. 6–12.

8. *Sepiella affinis* (Eydoux et Souleyet).

1852. *Sepia affinis*, E. et S., Voy. "Bonite," p. 35, pl. iii. figs. 13, 14.

9. *Sepiella maindroni*, de Rochebrune (Pl. XXII. figs. 1–10; p. 149).

1884. *Sepiella Maindroni* Rochebr., Monogr. Sepiadæ, p. 89.

10. *Sepiella* (?) *dabryi* (de Rochebrune).

1884. *Diphtherosepion Dabryi*, Rochebr., Monogr. Sepiadæ, p. 81.

11. *Sepiella* (?) *martini* (de Rochebrune).

1884. *Diphtherosepion Martini*, Rochebr., Monogr. Sepiadæ, p. 81.

Hemisepius, Steenstrup, 1875.

1. *Hemisepius typicus*, Steenstrup.

1875. *Hemisepius typicus*, Stp., Hemisepius, pp. 465–479, pl. i. figs. 1–10; pl. ii. fig. 1.

Family IX. Loliginei, Steenstrup, 1861.

Sepioteuthis, Blainville, 1825.

Chondrosepia, Leuckart.

1. *Sepioteuthis sepioidea* (Blainville), d'Orbigny.

1823. *Loligo sepioidea*, Blv., Journ. de Phys., t. xcvi. p. 123.
1839. *Sepioteuthis sepioidea*, d'Orb., Céph. acét., p. 298; Sépioteuthes, pl. vii.
1875. „ „ Stp., Hemisepius, p. 478, pl. ii. figs. 7, 8.

2. *Sepioteuthis blainvilliana*, Férussac.

1839. *Sepioteuthis Blainvilliana*, d'Orb., Céph. acét., p. 303; Sépioteuthes, pl. ii.

3. *Sepioteuthis australis*, Quoy et Gaimard.

1832. *Sepioteuthis australis*, Q. et G., Voy. "Astrolabe," t. ii. p. 77, pl. iv. fig. 1.
1839. „ „ d'Orb., Céph. acét., p. 300; Sépioteuthes, pl. v. fig. 5, pl. vi. figs. 15–21.
1883. „ „ M'Coy, Nat. Hist. Victoria, Decade vii., pls. lxxvi., lxxvii.

4. *Sepioteuthis ehrhardti*, Pfeffer.

1884. *Sepioteuthis Ehrhardti*, Pfr., Ceph. Hamb. Mus., p. 3, fig. 1.

5. *Sepioteuthis mauritiana*, Quoy et Gaimard.

1832. *Sepioteuthis mauritiana*, Q. et G., Voy. "Astrolabe," t. ii. p. 76, pl. iv. figs. 2–6.
1839. „ „ d'Orb., Céph. acét., p. 305; Sépioteuthes, pl. v. figs. 1–4, pl. vii. figs. 1–5.

6. *Sepioteuthis lunulata*, Quoy et Gaimard.

1832. *Sepioteuthis lunulata*, Q. et G., Voy. "Astrolabe," t. ii. p. 74, pl. iii. figs. 8–13.
1832. „ *guinensis*, Q. et G., *Op. cit.*, p. 72, pl. iii. figs. 1–7.
1839. „ *lunulata*, d'Orb., Céph. acét., p. 300; Sépioteuthes, pl. iii. fig. 1, pl. vi. figs. 1–8.

7. *Sepioteuthis ovata*, Gabb.

1868. *Sepioteuthis ovata*, Gabb., Amer. Journ. Conch., vol. iv. p. 193, pl. xvii.

8. *Sepioteuthis sloanii*, Leach, MS.

1849. *Sepioteuthis Sloanii*, Gray, B.M.C., p. 81.

9. *Sepioteuthis bilineata* (Quoy et Gaimard), d'Orbigny.

1832. *Sepia bilineata*, Q. et G., Voy. "Astrolabe," t. ii. p. 66, pl. ii. fig. 1.
1839. *Sepioteuthis bilineata*, d'Orb., Céph. acét., p. 301; Sépioteuthes, pl. iv. fig. 2.

10. *Sepioteuthis neoguinaica*, Pfeffer.

1884. *Sepioteuthis neoguinaica*, Pffr., Ceph. Hamb. Mus., p. 4, fig. 2.

11. *Sepioteuthis lessoniana*, Férussac (p. 151).

1826. *Sepioteuthis Lessoniana*, d'Orb., Tabl. méth., Ann. d. Sci. Nat., t. vii. p. 155.
1830. „ „ Lesson, Voy. "Coquille," Moll., p. 241, pl. xi.
1839. „ „ d'Orb., Céph. acét., p. 302; Sépioteuthes, pls. i., vi. figs. 9–14.

12. *Sepioteuthis loliginiformis* (Leuckart), d'Orbigny.

1828. *Chondrosepia loliginiformis*, Lkt., Atlas Reise im nördl. Afrika, Wirbell. Th., p. 21, tab. vi. fig. 1.
1831. *Sepioteuthis Hemprichii* (?), Ehrbg., Symb. Phys., Anim. Moll. Ceph.
1839. „ *loliginiformis*, d'Orb., Céph. acét., p. 299; Sépioteuthes, pl. iv. fig. 1.

(Species insufficiently characterised.)

13. *Sepioteuthis major*, Gray.[1]

1828. *Sepioteuthis major*, Gray, Spicil. Zool., p. 3, pl. iv. fig. 1.
1849. „ „ Gray, B.M.C., p. 83.

14. *Sepioteuthis madagascariensis*, Gray.

1849. *Sepioteuthis madagascariensis*, Gray, B.M.C., p. 80.

[1] The figure is very suggestive of *Thysanoteuthis rhombus*, Troschel, with which Gray's remark "the giant of the genus" would also agree.

15. *Sepioteuthis brevis*, Owen.

1881. *Sepioteuthis brevis*, Owen, Trans. Zool. Soc. Lond., vol. xi. part 5, p. 137, pl. xxvi. fig. 1.

16. *Sepioteuthis sinensis*, d'Orbigny.

1839. *Sepioteuthis sinensis*, d'Orb., Céph. acét., p. 304.

17. *Sepioteuthis arctipinnis*, Gould.

1852. *Sepioteuthis arctipinnis*, Gld., Moll. Wilkes Exped., p. 479, fig. 593.

Loligo, Lamarck, 1799.

1. *Loligo vulgaris*, Lamarck.

1799. *Loligo vulgaris*, Lmk., Mém. Soc. Hist. Nat. Paris, t. i. p. 11.
1823. „ *pulchra*, Blv., Dict. d. Sci. Nat., t. xxvii. p. 144.
1833. „ *Rangii*, Fér., Céph. acét.; Calmars, pl. xix. figs. 4–6.
1839. „ *vulgaris*, d'Orb., Céph. acét., p. 308; Calmars, pls. viii.–x., xxii., xxiii. figs. 1–12.
1849. „ *neglecta*, Gray, B.M.C., p. 72.
1851. „ *Berthelotii* (?), Vér., Céph. médit., p. 93, pl. xxxvi. figs. h–k.
1869. „ *mediterranea*, Targ., Cef. Mus. Firenze, p. 36.
1869. „ *pulchra*, Fischer, Journ. de Conch., sér. 3, t. ix. p. 129.

2. *Loligo affinis*, Lafont.[1]

1871. *Loligo affinis*, Lafont, Actes Linn. Soc. Bordeaux, t. xxviii. p. 273, pl. xiii.
1872. „ „ Lafont, Journ. de Conch., sér. 3, t. xii. p. 22.

3. *Loligo macrophthalma*, Lafont.

1871. *Loligo macrophthalma*, Lafont, Actes Linn. Soc. Bordeaux, t. xxviii. p. 274, pl. xv.
1872. „ „ Lafont, Journ. de Conch., sér. 3, t. xii. p. 23.

4. *Loligo microcephala*, Lafont.

1871. *Loligo microcephala*, Lafont, Actes Linn. Soc. Bordeaux, t. xxviii. p. 273, pl. xiv.
1872. „ „ Lafont, Journ. de Conch., sér. 3, t. xii. p. 22.

5. *Loligo moulinsi*, Lafont.

1871. *Loligo Moulinsi*, Lafont, Actes Linn. Soc. Bordeaux, t. xxviii. p. 274.
1872. „ „ Lafont, Journ. de Conch., sér. 3, t. xii. p. 23.

6. *Loligo breviceps*, Steenstrup.

1861. *Loligo breviceps*, Stp., Vid. Meddel. nat. Foren. Kjøbenhavn, p. 289.
1871. „ *vulgaris*, Lenz, Jahresb. Comm. Kiel., Jahrg. i. p. 135.
1873. „ *brevipes*, Mörch, Nachrichtsbl. malak. Gesellsch., No. 5 (*err. typ.*) (*fide* Lenz).
1875. „ *breviceps*, Lenz, Jahresb. Comm. Kiel, Anhang., p. 23, pl. i. figs. 5, 6; pl. ii. figs. 1–9 (pub. 1878).

[1] I am inclined to suspect that some of Lafont's species are mere varieties, but as this opinion is based only on the brief published descriptions I refrain from giving it formal expression. It will be shown in the sequel (p. 157) that the greatest caution must be exercised in accepting distinctions based on the proportionate length of the body and fin.

7. *Loligo forbesii*, Steenstrup.

1856. *Loligo Forbesii*, Stp., Hectocotyl., p. 189, pl. i. fig. 2.
1858. „ *magna*, Adams, Gen. Rec. Moll., pl. iv. fig. 3.
1871. „ *Forbesii*, Lenz, Jahresb. Comm. Kiel, Jahrg. i. p. 135.
1885. „ „ Hoyle, Proc. Roy. Phys. Soc. Edin., vol. viii. p. 459.

8. *Loligo pealei*, Lesueur.

1821. *Loligo Pealii*, Les., Journ. Acad. Nat. Sci. Philad., p. 92.
1843. „ *punctata*, de Kay, Moll. New York, p. 3, pl. i. fig. 1.
1881. „ *Pealei*, Vll., Ceph. N. E. Amer., p. 308, pl. xxix. figs. 1–4; pl. xxxvii. figs. 1–3; pl. xxxix. fig. 4; pls. xl., xli.; pl. xlv. figs. 3, 4.

9. *Loligo edulis*, Hoyle (Pl. XXIII.; p. 152).

1885. *Loligo edulis*, Hoyle, Diagnoses II., p. 186.

10. *Loligo patagonica*, E. A. Smith.

1881. *Loligo patagonica*, E. A. Sm., Proc. Zool. Soc. Lond., p. 24, pl. iii. fig. 2.

11. *Loligo brasiliensis*, Blainville (p. 153).

1823. *Loligo brasiliensis*, Blv., Journ. de Phys., t. xcvi. p. 132.
1839. „ „ d'Orb., Céph. acét., p. 313; Calmars, pl. xii.; pl. xix. fig. 1; pl. xx. figs. 1–5.

12. *Loligo gahi*, d'Orbigny.

1835. *Loligo gahi*, d'Orb., Amér. mérid., p. 60, pl. iii. figs. 1, 2.
1839. „ „ d'Orb., Céph. acét., p. 316; Calmars, pl. xxi. figs. 3, 4.

13. *Loligo kobiensis*, Hoyle (Pl. XXV. figs. 1–10; p. 154).

1885. *Loligo kobiensis*, Hoyle, Diagnoses II., p. 184.

14. *Loligo pfefferi*, n. n.[1]

1884. *Loligo brevipinnis*, Pfr., Ceph. Hamb. Mus., p. 5, fig. 4.

15. *Loligo sumatrensis*, d'Orbigny.

1839. *Loligo sumatrensis*, d'Orb., Céph. acét., p. 317; Calmars, pl. xiii. figs. 1–3.

16. *Loligo spectrum*, Pfeffer.

1884. *Loligo spectrum*, Pfr., Ceph. Hamb. Mus., p. 5.

17. *Loligo duvaucelii*, d'Orbigny.

1839. *Loligo Duvaucelii*, d'Orb., Céph. acét., p. 318; Calmars, pls. xiv., xx. figs. 6–16.

18. *Loligo indica*, Pfeffer (Pl. XXVI.; p. 156).

1884. *Loligo indica*, Pfr., Ceph. Hamb. Mus., p. 4, fig. 3.

[1] The name proposed by Dr. Pfeffer too closely resembles *brevipinna*, already introduced into this genus by Lesueur. I have therefore taken the liberty of applying my friend's own name to the species.

19. *Loligo bleekeri*, Keferstein.

1866. *Loligo Bleekeri*, Bronn, Klass. u. Ord. d. Thierreichs, Bd. iii. p. 1402 ; pl. cxxii. figs. 9, 10; pl. cxxvii. fig. 14.
1882. „ „ Brock, Zeitschr. f. wiss. Zool., Bd. xxxvi. p. 604.
1886. „ „ Appellöf, Japanska Ceph., p. 31, pl. i. figs. 7–10.

20. *Loligo japonica*, Steenstrup, MS. (Pl. XXIV. figs. 7–15 ; p. 157).

1885. *Loligo japonica*, Hoyle, Diagnoses II., p. 187.

21. *Loligo galatheæ*, Steenstrup, MS. (Pl. XXVII.; p. 159).

1885. *Loligo galatheæ*, Hoyle, Diagnoses II., p. 183.

22. *Loligo subalata* (Gervais et van Beneden), Eydoux et Souleyet.

1838. *Sepiola subalata*, Gerv. et v. Ben., Bull. Acad. Sci. Bruxelles, t. v. p. 423.
1852. *Loligo subalata*, E. et S., Voy. "Bonite," p. 30, pl. iii. figs. 1–5.

23. *Loligo reynaudii*, d'Orbigny.

1839. *Loligo Reynaudii*, d'Orb., Céph. acét., p. 315 ; Calmars, pl. xxiv.

24. *Loligo plei*, Blainville.

1823. *Loligo Plei*, Blv., Journ. de Phys., t. xcvi. p. 132.
1839. „ „ d'Orb., Céph. acét., p. 312 ; Calmars, pls. xvi., xxiv. figs. 9–13.

25. *Loligo media* (Linné).

1767. *Sepia media*, Linn., Syst. nat., ed. x. p. 659 ; No. 262, 3.
1799. *Loligo subulata*, Lmk., Mém. Soc. Hist. Nat. Paris, t. i. p. 15.
1823. „ *spiralis*, Fér., Dict. Class. Hist. Nat., t. iii. p. 67, No. 6.
1848. „ *parva*, d'Orb., Céph. acét., p. 310 ; Calmars, pls. xvii., xxiii. figs. 19–21.
1849. *Teuthis parva*, Gray, B.M.C., p. 76.
1851. *Loligo marmoræ (?)*, Vér., Céph. médit., p. 95, pl. xxxvii.

26. *Loligo (?) ellipsura*, Hoyle (Pl. XXIV. figs. 1–6 ; Pl. XXV. figs. 11–15 ; p. 160).

1885. *Loligo ellipsura*, Hoyle, Diagnoses II., p. 182.

(Species insufficiently characterised.)

27. *Loligo arabica* (Ehrenberg), Steenstrup.

1831. *Pteroteuthis arabica*, Ehrb., Symb. Phys., Anim. Moll. Ceph.
1845. *Ommastrephes arabicus*, d'Orb, Moll. viv., p. 428.
1880. *Loligo arabica*, Stp., Ommat. Blækspr., p. 95.

28. *Loligo australis*, Gray.

1849. *Loligo australis*, Gray, B.M.C., p. 71.

29. *Loligo chinensis*, Gray.

1849. *Loligo chinensis*, Gray, B.M.C., p. 74.

30. *Loligo emmakina*, Gray.

1849. *Loligo Emmakina*, Gray, B.M.C., p. 71.

31. *Loligo hardwickei*, Gray.

1849. *Loligo Hardwickei*, Gray, B.M.C., p. 69.

32. *Loligo hemiptera*, Howell.

1867. *Loligo hemiptera*, Howell, Amer. Journ. Conch., vol. iii. p. 239, pl. xiii.

33. *Loligo lanceolata*, Rafinesque.

1814. *Loligo lanceolata*, Raf., Précis. découv. somiol., p. 29 (*nomen tantum*).

34. *Loligo odogadium*, Rafinesque.

1814. *Loligo odogadium*, Raf., Précis. découv. somiol., p. 29 (*nomen tantum*).

35. *Loligo tricarinata*, Gray.

1849. *Loligo tricarinata*, Gray, B.M.C., p. 73.

36. *Loligo gronovii*, Férussac.

1839. *Loligo Gronovii*, Fér. and d'Orb., Céph. acét., p. 319.
1880. „ „ Stp., Ommat. Blækspr., p. 97.

Loliolus, Steenstrup, 1856.

1. *Loliolus typus*, Steenstrup.

1856. *Loliolus typus*, Stp., Hectocotyl., p. 194, pl. i. fig. 5.

2. *Loliolus affinis*, Steenstrup.

1856. *Loliolus affinis*, Stp., Hectocotyl., p. 194, pl. i. fig. 6.

3. *Loliolus steenstrupi*, Dall.

1871. *Loliolus Steenstrupi*, Dall, Amer. Journ. Conch., vol. vii. p. 97.

Lolliguncula, Steenstrup, 1881.

1. *Lolliguncula brevis* (Blainville), Steenstrup.

1823. *Loligo brevis*, Blv., Journ. de Phys., t. xcvi. p. 133.
1824. „ *brevipinna* (?), Les., Journ. Acad. Nat. Sci. Philad., vol. iii. p. 282, pl. x.
1839. „ *brevis*, d'Orb., Céph. acét., p. 314; Calmars, pl. xiii. figs. 4–6; pl. xv. fig. 13; pl. xxiv. figs. 14–19.
1881. *Lolliguncula brevis*, Stp., Sepiadarium og Idiosepius, p. 242.

Division II. ŒGOPSIDA, d'Orbigny, 1839.

Family X. Ommastrephini, Steenstrup, 1861.

Subfamily Thysanoteuthidæ, Keferstein, 1866.

Thysanoteuthis, Troschel, 1857.

1. *Thysanoteuthis rhombus*, Troschel.

1857. *Thysanoteuthis rhombus*, Trosch., Archiv f. Naturgesch., Jahrg. xxiii. Bd. i. p. 70, pl. iv. fig. 12; pl. v. figs. 1–4.
1881. „ „ Vigelius, Mitth. Zool. Stat. Neapel, Bd. ii. p. 150.

2. *Thysanoteuthis elegans*, Troschel.

1851. *Sepioteuthis sicula* (?), Vér., Céph. médit., p. 75, pl. xxvii.
1857. *Thysanoteuthis elegans*, Trosch., Archiv f. Naturgesch., Jahrg. xxiii. Bd. i. p. 74, pl. iv. figs. 10, 11.

Subfamily Ommastrephidæ, Gill, 1871.

Ommastrephes, d'Orbigny, 1835.

Sthenoteuthis, Verrill.

1. *Ommastrephes bartramii* (Lesueur), d'Orbigny.

1821. *Loligo Bartramii*, Les., Journ. Acad. Nat. Sci. Philad., vol. ii. p. 90, pl. vii.
1835. *Ommastrephes Bartramii*, d'Orb., Amér. mérid., p. 55.
1835. „ *cylindricus*, d'Orb., Céph. acét., p. 54; Calmars, pl. iii. figs. 3, 4.
1839. „ „ d'Orb., *Op. cit.*, p. 347; Calmars, pl. ii.; Ommast., pl. ii. figs. 11–20.
1880. *Ommatostrephes Bartramii*, Stp., Ommat. Blækspr., pp. 79, 81, figs.[1]

2. *Ommastrephes gigas*, d'Orbigny.

1835. *Ommastrephes gigas*, d'Orb., Amér. mérid., p. 50, pl. iv.
1839. „ *giganteus*, d'Orb., Céph. acét., p. 350; Calmars, pl. xx.

3. *Ommastrephes pteropus*, Steenstrup.

1822. *Loligo todaropterus* (?), d. Ch., Mem. stor anim., pl. xcv. (*fide* Stp.).
1823. „ *Brongnartii* (?), Blv., Dict. sci. nat., t. xxvii. p. 142.
1856. *Ommatostrephes pteropus*, Stp., Vid. Meddel. nat. Foren. Kjøbenhavn, Aar 1855, p. 117.
1862. „ „ Stp., *Op. cit.*, Aar 1861, p. 285.
1880. *Sthenoteuthis pteropus*, Vll., Céph. N. E. Amer., p. 228, pl. xxvi.
1881. *Ommastrephes ensifer* (?), Owen, Trans. Zool. Soc. Lond., vol. xi. pt. 5, p. 144, pl. xxviii.
1885. *Ommatostrephes pteropus*, Stp., Notæ Teuthol., V.

[1] The greater number of the species of *Ommastrephes* are mentioned, and their systematic positions indicated in this paper, so I have not thought it necessary to repeat the reference in every case.

Ommastrephes oualaniensis (Lesson), d'Orbigny (p. 162).

1830. *Loligo oualaniensis*, Less., Voy. "Coquille," Zool., p. 240, pl. i. fig. 2.
1832. „ *vanikoriensis*, Q. et G., Voy. "Astrolabe," t. ii. p. 79, pl. v. figs. 1, 2.
1832. „ *breviten taculata*, Q. et G., *Op. cit.*, p. 81.
1839. *Ommastrephes oualaniensis*, d'Orb., Céph. acét., p. 351; Calmars, pls. iii., xxi.; Ommast. pl. i. figs. 14, 15.
1862. „ *Tryonii* (?), Gabb, Proc. Acad. Nat. Sci. Philad., p. 483, with plate.
1863. „ *Ayresii* (?), Gabb, Carpenter, Rep. W. C. Moll., p. 613.
1880. *Ommatostrephes oualaniensis*, Stp., Ommat. Blækspr., pp. 76, 84, &c.

5. *Ommastrephes pelagicus* (Bosc), d'Orbigny.

1802. *Sepia pelagica*, Bosc, Hist. nat., Vers, t. i. p. 46, pl. i. figs. 1, 2.
1839. *Ommastrephes pelagicus*, d'Orb., Céph. acét., p. 348; Calmars, pl. xviii. figs. 1, 2; Ommast., pl. i. figs. 17, 18.
1849. „ „ Gray, B.M.C., p. 63 (subgen. *Hyaloteuthis*).

6. *Ommastrephes megapterus* (Verrill), Steenstrup.

1878. *Architeuthis megaptera*, Vll., Amer. Journ. Sci. and Arts, vol. xvi. p. 207.
1880. *Sthenoteuthis megaptera*, Vll., Ceph. N. E. Amer., pp. 223, 286, pl. xxi. figs. 1–9; pl. xxvi.
1880. *Ommatostrephes megapterus*, Stp., Sthenoteuthis og Lestoteuthis, pp. 3–8.

(Species insufficiently characterised.)

7. *Ommastrephes eblanæ* (Ball), Gray.

1841. *Loligo Eblanæ*, Ball, Proc. Roy. Irish Acad., vol. i. p. 363, figs. 1–7.
1850. *Ommastrephes Eblanæ*, Forbes and Hanley, Brit. Moll., vol. iv. p. 235, pl. sss. fig. 2.

8. *Ommastrephes insignis*, Gould.

1852. *Ommastrephes insignis*, Gld., Moll. Wilkes Exped., p. 480, fig. 594.

9. *Ommastrephes crassus*, Lafont.

1871. *Ommastrephes crassus*, Lafont, Actes Linn. Soc. Bordeaux, t. xxviii. p. 275, pl. xvi.

10. *Ommastrephes æquipoda*, Rüppell.

1844. *Loligo æquipoda*, Rüpp., Giorn. Gab. Messina, t. xxvi. (*fide* Vér.).
1851. „ „ Vér., Céph. médit., p. 105, pl. xxxv. figs. *a*, *b*.

Dosidicus, Steenstrup, 1857.

1. *Dosidicus eschrichtii*, Steenstrup.

1857. *Dosidicus Eschrichtii*, Stp., Oversigt K. D. Vid. Selsk. Forhandl., p. 11.
1880. „ „ Stp., Ommat. Blækspr., pp. 79, 81, 89, with woodcuts.

2. *Dosidicus steenstrupii*, Pfeffer.

1884. *Dosidicus Steenstrupii*, Pffr., Ceph. Hamb. Mus., p. 20, fig. 27.

Todarodes, Steenstrup, 1880.

Ommastrephes, d'Orbigny (*pars*).

1. *Todarodes sagittatus* (Lamarck), Steenstrup.

1758. *Loliginis species maxima*, Seba, Rer. Nat. Thes., tom. iii. tab. iv. figg. 1, 2.
1799. *Loligo sagittata*, Lmk., Mém. Soc. Hist. Nat. Paris, t. i. p. 13.
1829. „ *todarus*, d. Ch., Mem. stor. anim., t. iv. p. 161, tav. lx.
1830. *Ommastrephes todarus*, d'Orb., Céph. acét., p. 349; Calmars, pl. i.; Ommast., pl. ii. figs. 4–10.
1880. *Todarodes sagittatus*, Stp., Ommat. Blækspr., pp. 83, 90, &c.

2. *Todarodes pacificus*, Steenstrup (Pl. XXVIII. figs. 1–5; p. 163).

1880. *Todarodes pacificus*, Stp., Ommat. Blækspr., pp. 83, 90, &c.
1886. *Ommastrephes pacificus*, Appellöf, Japanska Ceph., p. 35, pl. iii. figs. 8–10.

3. *Todarodes* (*?*) *sloanii* (Gray), Steenstrup.

1849. *Ommastrephes Sloanii*, Gray, B.M.C., p. 61.
1880. ———— (*?*) *Sloanei*, Stp., Ommat. Blækspr., p. 98.

Illex, Steenstrup, 1880.

Ommastrephes, d'Orbigny (*pars*).

1. *Illex illecebrosus* (Lesueur), Steenstrup.

1821. *Loligo illecebrosa*, Les., Journ. Acad. Nat. Sci. Philad., vol. ii. p. 95.
1825. „ *piscatorum*, La Pylaie, Ann. d. Sci. Nat., sér. 1, t. iv. p. 319.
1839. *Ommastrephes sagittatus*, d'Orb., Céph. acét., p. 345; Calmars, pls. iv., vi. (*pars*).
1880. *Illex illecebrosus*, Stp., Ommat. Blækspr., pp. 82, 90, &c.
1881. *Ommastrephes illecebrosa*, Vll., Ceph. N. E. Amer., p. 268, pl. xxviii.; pl. xxix. fig. 5; pl. xxxvii. fig. 8; pl. xxxix.

2. *Illex coindetii* (Vérany), Steenstrup.

1837. *Loligo Coindetii*, Vér., Mem. Accad. Sci. Torino, t. i. p. 94, pl. iv.
1839. *Ommastrephes sagittatus*, d'Orb., Céph. acét., p. 345; Ommast., pl. i. figs. 1–10 (*pars*).
1851. *Loligo Pillæ* (*?*), Vér., Céph. médit., p. 112; pl. xxxvi. figs. d–g.
1880. *Illex Coindetii*, Stp., Ommat. Blækspr., pp. 82, 90, &c.

Architeuthus, Steenstrup, 1856.[1]

Architeuthis, Auctt.

1. *Architeuthus monachus*, Steenstrup.

1857. *Architeuthis monachus*, Stp., Coloss. Blækspr., p. 182 (*nomen tantum*).
1861. „ *dux*, Harting, Verhandel. k. Akad. Weten., Dl. ix. p. 11, pl. i.
1880. „ *monachus*, Vll., Ceph. N. E. Amer., pp. 238–245.
1880. „ *Hartingii* (*?*), Vll., *Op. cit.*, p. 240.

2. *Architeuthus dux*, Steenstrup.

1857. *Architeuthis dux*, Stp., Coloss. Blækspr., p. 128 (*nomen tantum*).
1862. *Loligo Bouyeri*, Crosse et Fischer, Journ. de Conch., sér. 3, t. ii. p. 138.
1875. *Architeuthis dux*, Gervais, Journ. de Zool., t. iv. p. 90.
1880. „ „ Vll., Ceph. N. E. Amer., p. 238.

3. *Architeuthus harveyi* (Kent), Verrill.

1874. *Megaloteuthis Harveyi*, Kent, Proc. Zool. Soc. Lond., pp. 178, 489.
1880. *Architeuthis Harveyi*, Vll., Ceph. N. E. Amer., p. 197, pls. xiii.–xvia.
1882. „ „ Vll., *Op. cit.*, p. 422.

4. *Architeuthus princeps*, Verrill.

1875. *Architeuthis princeps*, Vll., Amer. Journ. Sci. and Arts, vol. ix. pp. 124, 181, pl. v.
1880. „ „ Vll., Ceph. N. E. Amer., p. 210, pls. xvii.–xx.

5. *Architeuthus martensi* (Hilgendorf), Steenstrup.

1880. *Megateuthus Martensii*, Hilgd., Sitzungsb. naturf. Freunde Berlin, p. 65.
1882. *Architeuthus martensii*, Stp., Notæ Teuthol. III., p. 157.

6. *Architeuthus grandis* (Owen), Verrill.

1881. *Plectoteuthis grandis*, Owen, Trans. Zool. Soc. Lond., vol. xi. pt. 5, p. 156, pls. xxxiv., xxxv.
1881. *Architeuthis grandis*, Vll., Ceph. N. E. Amer., p. 400.
1882. *Architeuthus* sp., Stp., Notæ Teuthol. IV., p. 164.

Mouchezia,[2] Vélain, 1877.

1. *Mouchezia sancti-pauli*, Vélain.

1877. *Mouchezis Sancti-Pauli*, Vélain, Archives d. Zool. expér., t. vi. p. 83, fig. S. (*err. typ. ?*)

[1] For generic characters see Steenstrup, Ommat. Blækspr., p. 102; and Vll., Ceph. N. E. Amer., p. 197.
[2] The validity of this genus is very doubtful.

Tracheloteuthis, Steenstrup, 1881.

Verrilliola, Pffr.
Entomopsis, Rochebr. (?).

1. *Tracheloteuthis riisei*, Steenstrup (Pl. XXVIII. figs. 6–12 ; p. 164).

1881. *Tracheloteuthis Riisei*, Stp., Vid. Meddel. nat. Foren. Kjøbenhavn, p. 294.
1884. *Verrilliola gracilis* (?), Pffr., Ceph. Hamb. Mus., p. 22, fig. 28.

2. *Tracheloteuthis behnii*, Steenstrup.

1881. *Tracheloteuthis Behnii*, Stp., Vid. Meddel. nat. Foren. Kjøbenhavn, p. 294.
1884. *Verrilliola nympha* (?) Pffr., Ceph. Hamb. Mus., p. 23, fig. 29.

3. *Tracheloteuthis* (?) *velaini* (de Rochebrune).

1884. *Entomopsis Velaini*, Rochebr., Monogr. Loligopsidæ, p. 21, pl. ii. figs. 7–11.

4. *Tracheloteuthis* (?) *clouei* (de Rochebrune).

1884. *Entomopsis Clouei*, Rochebr., Monogr. Loligopsidæ, p. 22.

Bathyteuthis, Hoyle, 1885.

Benthoteuthis, Verrill.

1. *Bathyteuthis abyssicola*, Hoyle (Pl. XXIX. figs. 1–7 ; p. 168).

1885. *Bathyteuthis abyssicola*, Hoyle, Narr. Chall. Exp., p. 272, fig. 108.
1885. „ „ Hoyle, Prelim. Rep. II., p. 308, fig. 2.

2. *Bathyteuthis megalops* (Verrill).

1885. *Benthoteuthis megalops*, Verrill, Third Catal., p. 402, pl. xliv. fig. 1.

Steenstrupiola, Pfeffer, 1884.

1. *Steenstrupiola chilensis*, Pfeffer.

1884. *Steenstrupiola chilensis*, Pffr., Ceph. Hamb. Mus., p. 16, fig. 20.

2. *Steenstrupiola atlantica*, Pfeffer.

1884. *Steenstrupiola atlantica*, Pffr., Ceph. Hamb. Mus., p. 17, fig. 21.

Subfamily MASTIGOTEUTHIDÆ, Verrill, 1881.

Mastigoteuthis, Verrill, 1881.

1. *Mastigoteuthis agassizii*, Verrill (Pl. XXIX. figs. 8–10 ; p. 170).

1881. *Mastigoteuthis Agassizii*, Vll., "Blake" Rep., p. 100, pls. i., ii. figs. 2, 3.
1881. „ „ Vll., Ceph. N. E. Amer., p. 297, pls. xlviii., xlix. figs. 2, 3.

Family XI. Onychii, Steenstrup, 1861.

Subfamily Onychoteuthidæ, Gray, 1849 (*sensu stricto*).

Enoploteuthis, d'Orbigny, 1839.

1. *Enoploteuthis leptura* (Leach), d'Orbigny.

1817. *Loligo leptura*, Leach, Zool. Miscell., vol. iii. p. 141 (*err. typ.*).
1817. „ *Smythii*, Leach, *Ibid.*
1839. *Enoploteuthis leptura*, d'Orb., Céph. acét., p. 337; Onychot., pl. vi., pl. xi. figs. 6–14, pl. xii. figs. 10–24.
1849. „ *Smithii*, Gray, B.M.C., p. 47.

2. *Enoploteuthis margaritifera*, Rüppell (Pl. XXIX. fig. 11; p. 171).

1844. *Enoploteuthis margaritifera*, Rüpp., Giorn. Gab. Messina, t. xxvi. p. 2, fig. 1 (*fide* Vér.).
1851. „ „ Vér., Céph. médit., p. 82, pl. xxx. fig. a.
1858. „ „ Claus, Archiv f. Naturgesch., Jahrg. xxiv. Bd. i. p. 262, Taf. x. fig. 2.

3. *Enoploteuthis pallida*, Pfeffer.

1884. *Enoploteuthis pallida*, Pffr., Ceph. Hamb. Mus., p. 18, fig. 23.

4. *Enoploteuthis hoylei*, Pfeffer.

1884. *Enoploteuthis Hoylei*, Pffr., Ceph. Hamb. Mus., p. 17, fig. 22.

Cucioteuthus, Steenstrup, 1882.

Enoploteuthis, Auctt. (*pars*).

1. *Cucioteuthus unguiculatus* (Molina), Steenstrup.

1782. *Sepia unguiculata*, Molina, Saggio Stor. Nat. Chili, p. 199 (*fide* d'Orb.).
1818. *Onychoteuthis Molinæ*, Licht., Sepien mit Krallen, p. 13.
1861. ————————, Harting, Verhandel. k. Akad. Weten., Dl. ix. pl. iii. figs. 16, 17.
1881. *Enoploteuthis Cookii*, Owen, Trans. Zool. Soc. Lond., vol. xi. pt. 5, p. 150, pls. xxx.–xxxii.; pl. xxxiii. fig. 1 (*pars*).
1882. *Cucioteuthus unguiculatus*, Stp., Notæ Teuthol. III., p. 153.

Ancistrocheirus, Gray, 1849.

Enoploteuthis, Auctt. (*pars*).

1. *Ancistrocheirus lesueurii* (d'Orbigny et Férussac), Gray.

1839. *Enoploteuthis Lesueurii*, d'Orb. et Fér., Céph. acót., p. 339; Onychot., pl. xi. figs. 1–5; pl. xiv. figs. 4–10.
1849. *Ancistrocheirus Lesueurii*, Gray, B.M.C., p. 49.

2. *Ancistrocheirus megaptera*, Verrill.

1885. *Ancistrocheirus megaptera*, Vll., Third Catal., p. 399, pl. xlii. fig. 1.

Abralia, Gray, 1849.

Enoploteuthis, Auctt. (*pars*).

1. *Abralia armata* (Quoy et Gaimard), Gray.

1832. *Onychoteuthis armatus*, Q. et G., Voy. "Astrolabe," t. ii. p. 84, pl. v. figs. 14–22.
1839. *Enoploteuthis armata*, d'Orb., Céph. acét., p. 340; Onychot., pl. ix. figs. 2–6, pl. xiv. figs. 11–15.
1849. *Abralia armata*, Gray, B.M.C., p. 50.

2. *Abralia morisii* (Vérany), Gray.

1837. *Onychoteuthis Morisii*, Vér., Mem. Accad. Sci. Torino, ser. 2, t. i. p. 100, pl. ii.
1849. *Abralia Morisii*, Gray, B.M.C., p. 50.

3. *Abralia veranyi* (Rüppell).

1844. *Enoploteuthis Veranyi*, Rüpp., Giorn. Gab. Messina, t. xxvi. p. 3, fig. 2 (*fide* Vér.).
1851. „ „ Vér., Céph. médit., p. 83, pl. xxx. fig. b.

4. *Abralia oweni* (Vérany).

1851. *Enoploteuthis Owenii*, Vér., Ceph. médit., p. 84, pl. xxx. figs. c, d.
1858. „ „ Claus, Archiv f. Naturgesch., Jahrg. xxiv. Bd. i. p. 261, pl. x. fig. 1.

5. *Abralia polyonyx* (Troschel).

1857. *Enoploteuthis polyonyx*, Trosch., Archiv f. Naturgesch., Jahrg. xxiii. Bd. i. p. 87, pl. iv. fig. 9.

6. *Abralia megalops*, Verrill.

1882. *Abralia megalops*, Vll., Amer. Journ. Sci. and Arts, vol. xxiv. p. 364.
1883. „ „ Vil., "Blake" Suppl., p. 105, pl. iii. fig. 4.
1884. „ „ Vll., Second Catal., p. 143, pl. xxviii. fig. 2.

Verania, Krohn, 1847.

Octopodoteuthis, Krohn et Rüppell, Gray.

1. *Verania sicula*, Krohn.

1844. *Octopoteuthis sicula*, Rüpp., Giorn. Gab. Messina, t. xxxvi. p. 6 (*fide* Vér.).
1845. *Octopodoteuthis sicula*, Krohn, Archiv f. Naturgesch., Jahrg. xi. Bd. i. p. 47, pl. v.
1851. *Verania sicula*, Vér., Céph. médit., p. 78, pl. xxviii.
1884. *Octopodoteuthis sicula*, Pfr., Ceph. Hamb. Mus., p. 28.

Onychoteuthis, Lichtenstein, 1818.

1. *Onychoteuthis banskii* (Leach), Férussac.[1]

1817. *Loligo Banskii*, Leach, Zool. Miscell., vol. iii. p. 141.
1839. *Onychoteuthis Banskii*, d'Orb. et Fér., Céph. acét., p. 332; Onychot., pl. i., pl. ii. figs. 1, 2, pls. iii.–v. figs. 1–3, pl. ix. fig. 1, pl. xii. figs. 1–9.
1821. *Onykia angulata*, Les., Journ. Acad. Nat. Sci. Philad., vol. ii. p. 99, pl. ix. fig. 3.

2. *Onychoteuthis fusiformis*, Gabb.

1862. *Onychoteuthis fusiformis*, Gabb, Proc. Calif. Acad. Nat. Sci., vol. ii. p. 171.

3. *Onychoteuthis æquimanus*, Gabb.

1868. *Onychoteuthis æquimanus*, Gabb, Amer. Journ. Conch., vol. iv. p. 23, pl. ii.

4. *Onychoteuthis lobipennis*, Dall.

1872. *Onychoteuthis lobipennis*, Dall, Amer. Journ. Conch., vol. vii. p. 96.

5. *Onychoteuthis raptor*, Owen.

1881. *Onychoteuthis raptor*, Owen, Trans. Zool. Soc. Lond., vol. xi. pt. 5, p. 148, pl. xxix.

6. *Onychoteuthis ingens*, E. A. Smith.

1881. *Onychoteuthis ingens*, E. A. Sm., Proc. Zool. Soc. Lond., p. 25, pl. iii. fig. 1.

7. *Onychoteuthis brachyptera*, Pfeffer.

1884. *Onychoteuthis brachyptera*, Pffr., Ceph. Hamb. Mus., p. 20, fig. 26.

(Species insufficiently characterised.)

8. *Onychoteuthis rutilus*, Gould.

1852. *Onychoteuthis rutilus*, Gld., Moll. Wilkes Exped., p. 482, fig. 595.

9. *Onychoteuthis brevimanus*, Gould.

1852. *Onychoteuthis brevimanus*, Gld., Moll. Wilkes Exped., p. 483, fig. 596.

10. *Onychoteuthis* (*?*) *longimanus*, Steenstrup.

1857. *Onychoteuthis* (*?*) *longimanus*, Stp., Vid. Meddel. nat. Foren. Kjøbenhavn, Aar 1856, p. 120.
1875. „ (*??*) *lorigera*, Stp., Hemisepius, p. 473.

[1] This species has also at various times received the specific names *Lessonii*, *Beryii*, *Bartlingii*, *Bellonii*, *Fleurii*, a full account of which is given by d'Orbigny (*loc. cit.*).

Ancistroteuthis, Gray, 1849.

Onychoteuthis, Auctt. (*pars*).
Moroteuthis, Verrill.
Lestoteuthis, Verrill (*pars*).

1. *Ancistroteuthis lichtensteinii* (Férussac), Gray.

1839. *Onychoteuthis Lichtensteinii*, Fér., Céph. acét., p. 334; Onychot., pls. viii., xiv. figs. 1–3.
1849. *Ancistroteuthis Lichtensteinii*, Gray, B.M.C., p. 55.
1851. *Onychoteuthis Lichtensteinii*, Vér., Céph. médit., p. 78, pl. xxix. figs. a–c.

2. *Ancistroteuthis dussumieri* (d'Orbigny), Gray.

1839. *Onychoteuthis Dussumieri*, d'Orb., Céph. acét., p. 335; Onychot., pl. xiii.
1849. *Ancistroteuthis Dussumieri*, Gray, B.M.C., p. 56.

3. *Ancistroteuthis robusta* (Dall), Steenstrup.

1873. *? Onychoteuthis Bergi*, Dall, American Naturalist, vol. vii. p. 484.
1876. *Omnastrephes robustus*, Dall MS., Vll., Amer. Journ. Sci. and Arts, vol. xii. p. 236.
1880. *Onychoteuthis robusta*, Vll., Ceph. N. E. Amer., p. 246, pls. xxiii., xxiv.
1880. *Ancistroteuthis robusta*, Stp., Sthenoteuthis og Lestoteuthis, p. 19.
1881. *Moroteuthis robusta*, Vll., Ceph., N. E. Amer., p. 393.
1882. *Ancistroteuthis robusta*, Stp., Notæ Teuthol. II., p. 150.

Teleoteuthis,[1] Verrill, 1882.

Onychia, Lesueur.
Onychoteuthis, Auctt. (*pars*).

1. *Teleoteuthis caribbæa* (Lesueur), Verrill (Pl. XXX. figs. 1–8; p. 172).

1821. *Onykia carribæa*, Les., Journ. Acad. Nat. Sci. Philad., vol. ii. p. 98, pl. ix. figs. 1, 2 *a–e*.
1839. *Onychoteuthis cardioptera*, d'Orb., Céph. acét., p. 333; Cranchies, pl. i.; Onychot., pl. v. figs. 4–6 (*pars ?*).
1849. *Onychia cardioptera*, Gray, B.M.C., p. 57.
1882. *Teleoteuthis carribæa*, Vll., Ceph. N. E. Amer. (Fish Comm. Rep.), p. 70.
1884. *Onychia binotata* (*?*), Pfr., Ceph. Hamb. Mus., p. 19, fig. 24.

2. *Teleoteuthis platyptera* (d'Orbigny), Verrill.

1835. *Onychoteuthis platyptera*, d'Orb., Amér. mérid., p. 41, pl. iii. figs. 8–11.
1839. „ *platyptera*, d'Orb., Céph. acét., p. 335; Onychot., pl. x. figs. 8–10, pl. xiv. figs. 14–22.

3. *Teleoteuthis peratoptera* (d'Orbigny).

1835. *Onychoteuthis peratoptera*, d'Orb., Amér. mérid., p. 39, pl. iii. figs. 5–7.

[1] It is not without a feeling of regret that one abandons a generic name so time-honoured as that of Lesueur, but since the name is preoccupied, and since Verrill has proposed a new one, there seems no longer any excuse for retaining it.

4. *Teleoteuthis curta* (Pfeffer).

1884. *Onychia curta*, Pffr., Ceph. Hamb. Mus., p. 19, fig. 25.

5. *Teleoteuthis krohnii* (Vérany), Verrill.

1851. *Onychoteuthis Krohnii*, Vér., Céph. médit., p. 80, pl. xxix. figs. *d*, *e*.
1851. *Loligo Bianconii* (*?*), Vér., *Ibid.*, p. 100, pl. xxxv. figs. *i–l*.
1880. *Onychia Krohnii*, Stp., Sthenoteuthis og Lestoteuthis, p. 19 (note).
1882. *Teleoteuthis Krohnii*, Vll., Ceph. N. E. Amer. (Fish. Comm. Rep.), p. 70.

6. *Teleoteuthis agilis*, Verrill.

1885. *Teleoteuthis agilis*, Vll., Third Catal., p. 400, pl. xlii. fig. 2.

7. *Teleoteuthis* (*?*) *meneghini* (Vérany).

1851. *Loligo Meneghini*, Vér., Céph. médit., p. 98, pl. xxxiv. figs. *e*, *e*.
1880. *Onychia* (*?*) *Meneghini*, Stp., Ommat. Blækspr., p. 99.

Subfamily GONATIDÆ, nov.

Gonatus, Gray, 1849.

Sepia Loligo, Fabricius.
Onychoteuthis, Lichtenstein, Møller, Middendorff.
Owenia, Prosch (*pars*).
Lestoteuthis, Verrill (*pars*).
Cheloteuthis, Verrill.

1. *Gonatus fabricii* (Lichtenstein), Steenstrup (p. 174).*

1780. *Sepia loligo*, Fabr., Faun. grœnl., p. 358.
1818. *Onychoteuthis Fabricii*, Licht., Sepien mit Krallen, p. 13.
1842. „ „ Møller, Ind. Moll. grœnl., p. 3.
1842. „ (*?*) *amœna*, Møller, *Ibid.*, p. 3.
1849. „ *Kamtschatica*, Middff., Mém. Acad. Sci. St. Petersb., sér. 6, t. vi. p. 515, pl. xii. figs. 1–6.
1849. *Gonatus amœna*, Gray, B.M.C., p. 68.
1858. *Gonatus amœna*, Adams, Gen. Rec. Moll., p. 36, pl. iv. fig. 2.
1878. „ *amœnus*, Sars, Moll. Reg. Arct. Norv., p. 336, pl. xxxi.
1880. *Lestoteuthis Kamtschatica*, Vll., Ceph. N. E. Amer., p. 251.
1880. *Gonatus Fabricii*, Stp., Sthenoteuthis og Lestoteuthis, p. 9, pl. i.
1881. „ „ Vll., Ceph. N. E. Amer., p. 291, pl. xlv. figs. 1, 2.
1881. *Cheloteuthis rapax*, Vll., *Op. cit.*, p. 293, pl. xlix. fig. 1.
1881. *Lestoteuthis Fabricii*, Vll., *Op. cit.*, pp. 387–393, pl. xlv. figs. 1, 2; pl. xlix. fig. 1; pl. lv. fig. 1.
1882. *Gonatus Fabricii*, Stp., Notæ Teuthol. I., p. 143.

Of uncertain relationship.

——— *carunculata* (Schneider).

1788. *Sepia carunculata*, Schneider, Beobacht. u. Entdeck., Bd. v. p. 42 (*fide* d'Orb.).
1845. *Loligo carunculata*, d'Orb., Moll. viv., p. 352.

Family XII. Taonoteuthi, Steenstrup, 1861.

Subfamily Chiroteuthidæ, Gray, 1849.

Chiroteuthis, d'Orbigny, 1839.

Loligopsis, Férussac (*pars*).

1. *Chiroteuthis veranyi* (Férussac), d'Orbigny.

1835. *Loligopsis Veranyi*, Fér., Mag. de Zool., ann. v., cl. v., pl. lxv.
1839. *Chiroteuthis Veranyi*, d'Orb., Céph. acét., p. 325; Calmarets, pls. ii., iv. figs. 17–23.
1851. *Loligopsis Veranyi*, Vérany, Céph. médit., p. 120, pls. xxxviii., xxxix.

2. *Chiroteuthis bonplandi* (Vérany), d'Orbigny.

1837. *Loligopsis Bonplandi*, Vér., Mem. Accad. Sci. Torino, ser. 2; t. i. p. 99, pl. i.
1839. *Chiroteuthis Bonplandi*, d'Orb., Céph. acét., p. 326.

3. *Chiroteuthis lacertosa*, Verrill.

1881. *Chiroteuthis bonplandi* (?), Vll., "Blake" Rep., p. 102, pl. iii. fig. 1.
1881. „ *lacertosa*, Vll., Ceph. N. E. Amer., pp. 299, 408, pl. xlvii. fig. 1; pl. lvi. fig. 1.

Histiopsis, Hoyle, 1885.

1. *Histiopsis atlantica*, Hoyle (Pl. XXX. figs. 9–15; p. 180).

1885. *Histiopsis atlantica*, Hoyle, Narr. Chall. Exp., vol. i. p. 273 (*nomen tantum*).
1885. „ „ Hoyle, Diagnoses II., p. 201.

Calliteuthis, Verrill, 1880.

Loligopsis, Owen (*pars*).

1. *Calliteuthis reversa*, Verrill (Pl. XXXIII. figs. 12–15; p. 183).

1880. *Calliteuthis reversa*, Vll., Amer. Journ. Sci. and Arts, vol. xx. p. 393.
1881. „ „ Vll., Ceph. N. E. Amer., p. 295, pl. xlvi. fig. 1.
1884. „ „ Vll., Second Catal., p. 243.

2. *Calliteuthis ocellata* (Owen), Verrill.

1881. *Loligopsis ocellata*, Owen, Trans. Zool. Soc. Lond., vol. xi. pt. 5, pp. 139–143, pl. xxvi. figs. 3–8; pl. xxvii.
1881. *Calliteuthis ocellata*, Vll., Ceph. N. E. Amer., p. 402.

Brachioteuthis,[1] Verrill, 1881.

1. *Brachioteuthis beanii*, Verrill.

1881. *Brachioteuthis Beanii*, Vll., Ceph. N. E. Amer., p. 406, pl. lv. fig. 3; pl. lvi. fig. 2.

Doratopsis, de Rochebrune, 1884.

Hyaloteuthis, Pfeffer.
Leptoteuthis, Verrill.

1. *Doratopsis vermicularis* (Rüppell), de Rochebrune.[2]

1844. *Loligopsis vermicularis*, Rüpp., Giorn. Gab. Messina, t. xxvi. (*fide* Vér.).
1851. ,, ,, Vér., Céph. médit., p. 123, pl. xl. figs. *a*, *b*.
1884. *Doratopsis vermicularis*, Rochebr., Monogr. Loligopsidæ, p. 18.
1884. ,, *Rüppelli*, Rochebr., *Ibid.*, p. 19.
1884. *Hyaloteuthis vermicularis*, Pfr., Ceph. Hamb. Mus., p. 28, fig. 30.
1884. *Leptoteuthis vermicolaris*, Vll., Second Catal., p. 143.
1885. *Doratopsis vermicularis*, Hoyle, Loligopsis, p. 329.

2. *Doratopsis diaphana* (Verrill).

1884. *Leptoteuthis diaphana*, Vll., Second Catal., p. 141, pl. xxxii. fig. 1.

Histioteuthis, d'Orbigny, 1839.

Cranchia, Férussac (*pars*).

1. *Histioteuthis bonelliana* (Férussac), d'Orbigny.

1835. *Cranchia Bonelliana*, Fér., Mag. de Zool., ann. v., cl. v., pl. lxvi.
1839. *Histioteuthis Bonelliana*, d'Orb., Céph. acét., p. 327; Cranchies, pl. ii.

[1] "This genus probably includes the *Chiroteuthis bonplandi*, Vérany, from the eastern Atlantic" (Verrill, *op. cit.*, p. 405).

[2] It is not a little remarkable that this curious species should have remained undisturbed for forty years in the genus *Loligopsis*, and that then within a year no less than three genera should have been formed for its reception. It is rather unfortunate that the name proposed by de Rochebrune, who has only copied Vérany's very unsatisfactory diagnosis, should have preference over those suggested by Pfeffer and Verrill, who have added considerably to our knowledge of this genus; they have both, however, chosen names which were preoccupied (see Gray, B.M.C., p. 63, and d'Orb., Moll. viv., p. 363). With respect to the identity of the two forms figured by Vérany, Prof. Steenstrup informs me that he has had the opportunity of examining them both; a specimen of one (Vérany, *loc. cit.*, fig. *b*) was given by Krohn to Vérany, by Vérany to Kölliker, and by Kölliker to Steenstrup, and is now in the Copenhagen Museum; of the other (fig. *a*), Prof. Steenstrup examined the original specimen preserved in the Museum Senkenbergianum, Frankfort, and found that the shortness of the mantle was due to its having been folded, a fact which had not been observed owing to the transparency of the animal, and that the difference in the fin is owing to mutilation. The gladius, so far as he was able to examine it, presents some resemblance to the curious pen described on p. 178 of the present Report.

Dr. Pfeffer's generic name being invalid, it would be necessary to change the family name, which he has proposed (Hyaloteuthidæ), to correspond with the one which has the preference, but I think that for the present this form may be placed among the Chiroteuthidæ.

2. *Histioteuthis ruppelli*, Vérany.

1851. *Histioteuthis Ruppelli*, Vér., Céph. médit., p. 117, pls. xx., xxi.

3. *Histioteuthis collinsii*, Verrill.

1879. *Histioteuthis Collinsii*, Vll., Amer. Journ. Sci. and Arts, vol. xvii. p. 241.
1882. „ „ Vll., Ceph. N. E. Amer., pp. 234, 300, 404, pl. xxiii.; pl. xxvii. figs. 3–5; pl. xxxvii. fig. 5; pl. lv. fig. 6.

Family XIII. Cranchiæformes, Steenstrup, 1861.

Subfamily Cranchiadæ, Gray, 1849.

Cranchia, Leach, 1817.

1. *Cranchia scabra*, Leach.

1817. *Cranchia scabra*, Leach, Zool. Miscell., vol. iii. p. 140.
1836. „ „ Owen, Trans. Zool. Soc. Lond., vol. ii. p. 105 (with figs.).
1838. *Philonexis Eylais*, d'Orb., Céph. acét., p. 102; Poulpes, pl. xvii. figs. 4, 5.
1861. *Cranchia scabra*, Stp., Overblik, p. 72.

2. *Cranchia hispida*, Pfeffer.

1884. *Cranchia hispida*, Pffr., Ceph. Hamb. Mus., p. 27, fig. 37.

3. *Cranchia tenuitentaculata*, Pfeffer.

1884. *Cranchia tenuitententaculata*, Pffr., Ceph. Hamb. Mus., p. 26, fig. 36 (*err. typ.*).

4. *Cranchia megalops*, Prosch.

1847. *Cranchia megalops*, Prosch, K. dansk. Vidensk. Selsk. Skriv., Rk. 5, Bd. i. p. 64 (with figs.).
1861. „ „ Stp., Overblik, p. 77.

5. *Cranchia* (*?*) *maculata*, Leach.

1817. *Cranchia maculata*, Leach, Zool. Miscell., vol. iii. p. 140.

Subgenus, *Liocranchia*, Pfeffer, 1884.

6. *Cranchia brockii* (Pfeffer).

1884. *Liocranchia Brockii*, Pffr., Ceph. Hamb. Mus., p. 25, fig. 33.

7. *Cranchia reinhardtii*, Steenstrup (Pl. XXXI. figs. 11–14; Pl. XXXII. figs. 1–4; p. 184).

1856. *Leachia Reinhardtii*, Stp., Hectocotyl., p. 200.
1861. *Cranchia Reinhardtii*, Stp., Overblik., p. 76.
1884. *Liocranchia Reinhardtii*, Pffr., Ceph. Hamb. Mus., p. 25.

Taonius, Steenstrup, 1861.

Loligopsis, d'Orbigny, Tryon, de Rochebrune, &c.
Desmoteuthis, Verrill
Procalistes, Lankester.
Phasmatopsis, de Rochebrune.
Megalocranchia (?), Pfeffer.

1. *Taonius pavo* (Lesueur), Steenstrup.

1821. *Loligo pavo*, Lesueur, Journ. Acad. Nat. Sci. Philad., vol. ii. p. 96, pl.
1839. *Loligopsis pavo*, d'Orb., Céph. acét., p. 321; Calmars, pl. vi. (*excl.* fig. 4); Loligopsis, pl. iv. figs. 1–8 (*pars*).
1861. *Taonius pavo*, Stp., Overblik, pp. 70, 84.
1882. *Desmoteuthis hyperborea* (?), Vll., Ceph. N. E. Amer., p. 302, pl. xxvii. figs. 1, 2; pl. xxxix. fig. 1 (*excl. syn.*).
1885. *Taonius pavo*, Hoyle, Loligopsis, p. 318.

2. *Taonius hyperboreus*, Steenstrup (Pl. XXXII. fig. 12; Pl. XXXIII. figs. 1–11; p. 191).

1861. *Taonius hyperboreus*, Stp., Overblik., p. 83.
1882. *Desmoteuthis tenera* (?), Vll., Ceph. N. E. Amer., p. 412, pl. lv. fig. 2; pl. lvi. fig. 3.
1885. *Taonius hyperboreus*, Hoyle, Loligopsis, p. 321.

3. *Taonius cymoctypus* (de Rochebrune), Hoyle.

1839. *Loligopsis pavo*, d'Orb., Céph. acét., p. 321; Calmars, pl. vi. fig. 4 (?); pl. xxiii. figs. 10, 11. (*pars*).
1884. *Phasmatopsis cymoctypus*, Rochebr., Monogr. Loligopsidæ, p. 17, pl. i.
1885. *Taonius cymoctypus*, Hoyle, Loligopsis, p. 323.

4. *Taonius suhmi* (Lankester), (Pl. XXXII. figs. 5–11; p. 192).

1884. *Procalistes Suhmii*, Lankester, Quart. Journ. Micr. Sci., vol. xxiv. p. 311.

5. *Taonius elongatus*, Steenstrup, MS. (Pl. XXVIII. fig. 13; p. 189).

6. *Taonius schneehageni* (Pfeffer).[1]

1884. *Loligopsis Schneehagenii*, Pffr., Ceph. Hamb. Mus., p. 23, fig. 31.

7. *Taonius* (?) *maximus* (Pfeffer).[2]

1884. *Megalocranchia maxima*, Pffr., Ceph. Hamb. Mus., p. 24, fig. 32.

Pyrgopsis, de Rochebrune, 1884.

1. *Pyrgopsis rhynchophorus*, de Rochebrune.

1884. *Pyrgopsis rynchophorus*, Rochebr., Monogr. Loligopsidæ, p. 23, pl. ii. figs. 1–6.

[1] Dr. Pfeffer has been good enough to furnish me with a number of additional particulars regarding this form, which leave no doubt that it should be referred to the genus *Taonius*.

[2] If I am correct in referring this form to the genus *Taonius*, the specific designation is singularly unfortunate; *minimus* would have been more appropriate; but in the present state of our knowledge it is not worth while to burden the animal with another name.

Leachia, Lesueur, 1821 ; Steenstrup, 1861.

Anisoctus (*?*), Rafinesque.
Loligopsis (*pars*), d'Orbigny, Auctt.
Dyctyliopsis, de Rochebrune.
Perothis, Rathke.

1. *Leachia cyclura*, Lesueur.

1821. *Leachia cyclura*, Les., Journ. Acad. Nat. Sci. Philad., vol. ii. p. 90, pl. vi.
1833. *Loligopsis guttata*, Grant, Trans. Zool. Soc. Lond., vol. i. p. 24, pl. ii.
1833. *Perothis pellucida*, Rathke, Mém. Savans Étrang. St. Petersb., t. ii. p. 149.
1833. „ *Escholtzii*, Rathke, *Ibid.*
1861. *Leachia cyclura*, Stp., Overblik, p. 82.
1884. *Perothis Dussumieri*, Rochebr., Monogr. Loligopsidæ, p. 28.
1885. *Leachia cyclura*, Hoyle, Loligopsis, p. 326.

2. *Leachia ellipsoptera* (Adams and Reeve), Steenstrup.

1848. *Loligopsis ellipsoptera*, Ad. and Rv., Voy. "Samarang," Moll., p. 2.
1861. *Leachia ellipsoptera*, Stp., Overblik, p. 80.
1884. *Dyctyliopsis ellipsoptera*, Rochebr., Monogr. Loligopsidæ, p. 18.
1885. *Leachia ellipsoptera*, Hoyle, Loligopsis, p. 328.

3. *Leachia dubia* (Rathke), Hoyle.

1833. *Perothis dubia*, Rathke, Mém. Savans Étrang. St. Petersb., t ii. p. 170.
1885. *Leachia dubia*, Hoyle, Loligopsis, p. 329.

Loligopsis,[1] Lamarck, 1812.

Loligopsis, Auctt. (*pars*).

1. *Loligopsis peronii*, Lamarck.

1812. *Loligopsis Peronii*, Lmk., Extrait de son Cours de Zool., p. 123 (*fide* d'Orb.).
1861. „ „ Stp., Overblik., p. 85.
1885. „ „ Hoyle, Loligopsis, p. 314.

2. *Loligopsis zygæna*, Vérany.[2]

1851. *Loligopsis zygæna*, Vèr., Céph. medit., p. 125, pl. xl. fig. *c*.
1884. *Zygænopsis zygæna*, Rochebr., Monogr. Loligopsidæ, p. 20.
1885. ——— (*?*) *zygæna*, Hoyle, Loligopsis, p. 331.

[1] The true position of this genus is entirely uncertain : the description of the type species, based upon a drawing, is so fragmentary, that nothing can be extracted from it as to the affinities of the animal. See also note p. 20.

[2] This is certainly not a *Loligopsis* in the Lamarckian sense, but at present there is no ground for referring it to any known genus whatever, nor do I think its characters sufficiently well known to enable a new genus to be erected of it ; I therefore leave it as placed by the original describer. The name proposed by de Rochebrune is preoccupied.

Order II. TETRABRANCHIATA, Owen, 1832.

Family XIV. NAUTILIDÆ, Owen, 1836.

Nautilus,[1] Linné, 1757.

1. *Nautilus pompilius*, Linné (p. 199).

1758. *Nautilus pompilius*, Linn., Syst. Nat., ed. x. p. 708; No. 283, 232.
1868. „ „ Küster, Conch. Cab., sec. 55, p. 9, Taf. ii. fig. 2.

2. *Nautilus scrobiculatus*, Solander, MS.

... *Nautilus scrobiculatus*, Sol., Portl. Catal., No. 3653.
1868. „ „ Küster, Conch. Cab., sec. 55, p. 9, Taf. iii. figs. 1, 2.

3. *Nautilus macromphalus*, Sowerby.

1848. *Nautilus macromphalus*, Sow., Thes. Conch., p. 464, pl. xcviii. figs. 4, 5.
1868. „ „ Küster, Conch. Cab., sec. 55, p. 10, Taf. 3a.

4. *Nautilus umbilicatus*, Lister.

... *Nautilus umbilicatus*, Lister, Conch., pl. 552, fig. 4.
1868. „ „ Küster, Conch. Cab., sec. 55, p. 10, Taf. 3c. fig. 2.

5. *Nautilus stenomphalus*, Sowerby.

1848. *Nautilus stenomphalus*, Sow., Thes. Conch., p. 469, pl. xcvii. fig. 3.
1868. „ „ Küster, Conch. Cab., sec. 55, p. 11, Taf. 3b.

[1] Having no sufficient personal knowledge of the different species of this genus I have followed Küster (*loc. cit.*) in their enumeration; what study I have had the opportunity of giving them leads me to think that they may, perhaps, be reducible to two species, *Nautilus pompilius*, Linn., and *Nautilus umbilicatus*, Lister, with a number of more or less well marked varieties.

EXPLANATION OF THE MORE ABBREVIATED REFERENCES.

APPELLÖF, A.

Japanska Ceph.

Japanska Cephalopoder, *K. Svensk. Vetensk. Akad. Handl.*, Bd. xxi. No. 13, pp. 1–40, pls. i.–iii., 1886.

CHIAJE, STEFANO DELLE (d. Ch.).

Mem. stor. anim.

Memorie sulla storia e notomia degli animali senza vertebre del regno di Napoli, t. iv. Napoli, 1829.

DILLWYN, L. W.

Descr. Catal.

A Descriptive Catalogue of Recent Shells arranged according to the Linnæan Method, with Particular Attention to the Synonymy. London, 1817.

EYDOUX ET SOULEYET (E. et S.).

Voy. "Bonite."

Voyage autour du Monde exécuté pendant les années 1836 et 1837, sur la corvette la Bonite, commandée par M. Vaillant.—Zoologie, t. ii. Paris, 1852.

GOULD, A. A. (Gld.).

Moll. Wilkes Exped.

United States Exploring Expedition during the years 1838, 1839, 1840, 1841, 1842, under the Command of Charles Wilkes, U.S.N.—Vol. xii., Mollusca and Shells. Boston, 1852.

GRAY, JOHN EDWARD.

B. M. C.

Catalogue of the Mollusca in the Collection of the British Museum.—Part I., Cephalopoda Antepedia. London, 1849.

HOYLE, W. E.

Diagnoses I.

Diagnoses of new Species of Cephalopoda collected during the Cruise of H.M.S. Challenger.—Part I. The Octopoda. *Ann. and Mag. Nat. Hist.*, ser. 5, vol. xv. pp. 222–236, 1885.

Diagnoses II.

Diagnoses of new Species of Cephalopoda collected during the Cruise of H.M.S. Challenger.—Part II. The Decapoda. *Ann. and Mag. Nat. Hist.*, ser. 5, vol. xvi. pp. 181–203, 1885.

Prelim. Rep. I.

Preliminary Report on the Cephalopoda collected during the Cruise of H.M.S. Challenger.—Part I. The Octopoda. *Proc. Roy. Soc. Edin.*, vol xiii. pp. 94–114, with two woodcuts, 1885.

Prelim. Rep. II.

Preliminary Report on the Cephalopoda collected during the Cruise of H.M.S. Challenger.—Part II The Decapoda. *Proc. Roy. Soc. Edin.*, vol. xiii. pp. 281–310, with two woodcuts, 1885.

HOYLE, W. E.—*continued.*

Loligopsis.

On Loligopsis and some other genera. *Proc. Roy. Phys. Soc. Edin.*, vol. viii. pp. 313–333, 1885.

ISSEL, A.

Malacol. Mar Rosso.

Malacologia del Mar Rosso, ricerche zoologiche e paleontologiche. Pisa, 1869.

LENZ.

Jahresb. Comm. Kiel.

Jahresbericht der Commission zur wissenchaftlichen Untersuchung der deutschen Meere in Kiel, Jahrgang i., &c., 1871, &c. Berlin, 1873, 1878.

MÖLLER, H. P. C.

Ind. Moll. Groenl.

Index Molluscorum Groenlandiæ. *Krøyer, Nat. Hist. Tidsskr.*, Bd. iv. pp. 76–97, 1843; also (paged separately) Hafniæ, 1842.

D'ORBIGNY, ALCIDE (d'Orb.).

Amér. mérid.

Voyage dans l'Amérique méridionale exécuté pendant les années, 1826, 1827, 1828, 1829, 1830, 1831, 1832, et 1833.—Tom. v. partie 3, Mollusques. Paris et Strasbourg, 1835–1843.

Moll. viv.

Mollusques vivants et fossiles. Paris, 1845 and 1855.

Moll. Cuba.

Historie physique, politique et naturelle de l'Ile de Cuba, par M. Ramon de la Sagra.—Mollusques par Alcide d'Orbigny. Paris, 1853.

D'ORBIGNY, ALCIDE, ET FÉRUSSAC (d'Orb. et Fér.).

Céph. acét.

Histoire naturelle générale et particulière des céphalopodes acétabulifères, vivants et fossiles. Paris 1835–1848.

(Some of the plates of this work appear to have been issued prior to this date, for d'Orbigny quotes species as having been published in them as early as 1825.)

PFEFFER, G. (Pffr.).

Ceph. Hamb. Mus.

Die Cephalopoden des Hamburger Naturhistorischen Museums.—T. i. Neue Decapoden. *Abhandl. d. Naturwiss. Vereins Hamburg*, Bd. viii. Abth. 1, pp. 1–30, pls. i.–iii., 1884.

Quoy et Gaimard (Q. et G.).

Voy. "Astrolabe."

Zoologie du Voyage de l'Astrolabe, sous les ordres du Capitaine Dumont d'Urville, pendant les années 1826–29, t. ii. Paris, 1832.

Rafinesque, C. S. (Raf.).

Précis découv. somiol.

Précis de découvertes somiologiques ou zoologiques et botaniques. Palermo, 1814.

Good Book.

On the 3 genera of Cephalopodes—Ocythoe, Todarus, and Anisocbus. *The Good Book and Amenities of Nature, or Annals of Historical and Natural Sciences.* Philadelphia, 1840.

(The references to these papers are given on the authority of Binney and Tryon's edition of the author's collected works, New York, 1864.)

Rochebrune, Dr. A. T. de (Rochebr.).

Monogr. Loligopsidæ.

Étude monographique de la famille des Loligopsidæ. *Bull. Soc. philom. Paris*, sér. 7, t. viii. No. 1, pp. 7–28, pls. i., ii., 1884.

Monogr. Sepiadæ.

Étude monographique de la famille des Sepiadæ. *Bull. Soc. philom. Paris*, sér. 7, t. viii. pp. 74–122, pls. iii.-vi., 1884.

Monogr. Eledonidæ.

Étude monographique de la famille des Eledonidæ. *Bull. Soc. philom. Paris*, sér. 7, t. viii. pp. 152–163; pl. vii., 1884.

Smith, Edgar A. (E. A. Sm.).

"Alert" Rep.

Report on the Zoological Collections made in the Indo-Pacific Ocean during the Voyage of H.M.S. "Alert," 1881–82. London, 1884.

Steenstrup, Japetus (Stp.).

Hectocotyl.

Hectocotyldannelsen hos Octopodslægterne, Argonauta og Tremoctopus. *K. dansk. Vidensk. Selsk. Skriv.*, Rk. 4, Bd. iv. pp. 185–216, 1856.

(Translation by W. S. Dallas. *Ann. and Mag. Nat. Hist.*, ser. 2, vol. xx. pp. 81–114, 1857.)

Coloss. Blæksp.

Oplysninger om Atlanterhavets colossale Blæksprutter. *Skand. Naturf. Forhandl.*, vii. Möde, pp. 182–185, 1856.

STEENSTRUP, JAPETUS (Stp.)—*continued*.

Overblik.

Overblik over de i Kjöbenhavns Museer opbevarede Blæksprutter fra det aabne Hav. *Oversigt K. D. Vid. Selsk. Forhandl.*, pp. 69–86, 1861.

Hemisepius.

Hemisepius, en ny Slægt af Sepia-Blæksprutternes Familie, med Bemærkninger om Sepia-Formerne i Almindelighed. *K. dansk. Vidensk. Selsk. Skriv.*, Rk. 5, Bd. vii. pp. 465–482, pls. i., ii., 1875.

Ommat. Blækspr.

De Ommatostrephagtige Blæksprutters indbyrdes Forhold. *Oversigt K. D. Vid. Selsk. Forhandl.*, pp. 73–110, pl. iii., 1880.

Sthenoteuthis og Lestoteuthis.

Professor A. E. Verrils to nye Cephalopodslægter: Sthenoteuthis og Lestoteuthis. *Oversigt K. D. Vid. Selsk. Forhandl.*, pp. 1–27, pl. i., 1880.

Sepiella.

Sepiella Gray, Stp. *Vid. Meddel. nat. Foren. Kjøbenhavn*, pp. 347–356, figs. 1–8, 1880.

Sepiadarium og Idiosepius.

Sepiadarium og Idiosepius, to nye Slægter af Sepiernes Familie, med Bemærkninger om de to beslægtede Former Sepioloidea D'Orb. og Spirula Lmk. *K. dansk. Vidensk. Selsk. Skriv.*, Rk. 6, Bd. i. pp. 213–242, pl. i., 1881.

Notæ Teuthol.

Notæ Teuthologicæ. *Oversigt K. D. Vid. Selsk. Forhandl.*, pp. 143–168, 1882; pp. 109–127, 1885.

TARGIONI-TOZZETTI, ADOLFO (Targ.).

Cef. Mus. Firenze.

Commentario sui Cepalopodi mediterranei del R. Museo di Firenze. *Bull. malacol. ital.*, anno ii., pp. 141–162, 209–252, 1869.

(The paging in the references is taken from the separate copy.)

VÉRANY, J. B. (Vér.).

Céph. médit.

Mollusques méditeranéens, observés, décrits, figurés et chromolithographiés d'apres le vivant. Partie I, Céphalopodes de la Méditerranée. Gênes, 1851.

VERRILL, A. E. (Vil.).

"Blake" Rep.

Reports on the Results of Dredging, under the Supervision of Alexander Agassiz, on the East Coast of the United States during the Summer of 1880, by the U. S. Coast Survey Steamer "Blake," Commander J. R. Bartlett, U.S.N., Commanding. X.—Report on the Cephalopods, and on some additional Species dredged by the U. S. Fish Commission Steamer "Fish Hawk" during the Season of 1880. *Bull. Mus. Comp. Zoöl.*, vol. viii. No. 5, pp. 99–116, pls. i.–viii., 1881.

VERRILL, A. E. (VII.)—*continued.*

"Blake" Suppl.

Reports on the Results of Dredging, under the Supervision of Alexander Agassiz, in the Gulf of Mexico and in the Caribbean Sea (1878–79), by the U. S. Coast Survey Steamer "Blake," Lieut.-Commander C. D. Sigsbee, U. S. N., and Commander J. R. Bartlett, U. S. N., Commanding. XXIV.—Supplementary Report on the "Blake" Cephalopods. *Bull. Mus. Comp. Zoöl.*, vol. xi. No. 5, pp. 105–115, pls. i.–iii., 1883.

Also Descriptions of Two Species of Octopus from California, No. 6, pp. 117–124, pls. iv.–vi., 1883.

Ceph. N. E. Amer.

The Cephalopods of the North-Eastern Coast of America. Part I.—The Gigantic Squids (*Architeuthis*) and their allies; with observations on similar large species from foreign localities. *Trans. Connect. Acad.*, vol. v. part 1, pp. 177–257, pls. xiii.–xxv., 1880.

Part II.—The smaller cephalopods, including the "squids" and the octopi, with other allied forms. *Trans. Connect. Acad.*, vol. v. part 2, pp. 259–446, pls. xxvi.–xli., xlv.–lvi., 1881.

Also reprinted, with scarcely any variation, in Annual Report of the Commissioner of Fish and Fisheries for 1879, Washington, 1882.

(In references to the pages and plates, the former of these places is quoted as having been first published, in addition to which the index attached to the Fish Commission Report renders the indication of pages in it less necessary.)

Second Catal.

Second Catalogue of Mollusca recently added to the Fauna of the New England Coast and the adjacent parts of the Atlantic, consisting mostly of Deep-Sea Species, with Notes on others previously recorded. *Trans. Connect. Acad.*, vol. vi. part 1, pp. 139–294, pls. xxviii.–xxxii., 1884.

Third Catal.

Third Catalogue of Mollusca recently added to the Fauna of the New England Coast and the adjacent parts of the Atlantic, consisting mostly of Deep-Sea Species, with Notes on others previously recorded. *Trans. Connect. Acad.*, vol. vi. part 2, pp. 395–452, pls. xlii.–xliv., 1885.

DESCRIPTIONS OF GENERA AND SPECIES.

Every one who, within the last few years, has attempted the task of identifying a considerable collection of Cephalopoda must have felt great difficulty in deciding what forms were to be regarded as new; a result mainly owing to the brevity and insufficiency of the published descriptions of a large proportion of the hitherto known species. Taking warning by such experiences I have endeavoured to bequeath to my successors as little trouble in this respect as may be, though I cannot hope that there will not come a time when the diagnoses given below will be found inadequate to the requirements of the day. I have endeavoured, without being unduly prolix, to make mention of every feature in the appearance of the animal which could be of systematic significance, whether I have myself thought it of much importance in that respect or not.

The specimen has been invariably placed for descriptive purposes in a position, indicated in the annexed woodcut (Fig. 1), which agrees with what may be called the

FIG. 1.—Lateral view of a *Sepia*, showing the position in which the specimen is placed for description.

"morphological disposition" adopted by Lankester,[1] if the inclination to the horizontal, which is inconvenient for practical purposes, be neglected. In speaking of the arms, the side which is turned towards the mouth and bears the suckers has been called the "inner" and the opposite the "outer," and the same terms have been applied to the two surfaces of the interbrachial membrane or "umbrella." "Breadth" has always been used to signify a transverse measurement, and "length" a measurement parallel to the longitudinal axis of the animal, although, as in the fins of *Cirroteuthis*, the former may greatly exceed the latter. Several structures, to whose systematic value attention has been called by Steenstrup, have been called by translations of his names; thus "Hæftepuder" has been rendered by "fixing cushions." Other names which have been adopted for the parts of the shells of *Sepia* and for other structures will be explained as they arise.

[1] Ency. Brit., vol. xvi. p. 664, 1884.

Furthermore the attempt has been made to render the descriptions as easy of reference as possible, by arranging each in a series of uniform paragraphs and taking up the organs in a definite order.

Dimensions have been given in the case of new species, although, except as indicating general proportions, I do not attach much value to them, owing to the great contractility of the animals when alive, and to the irregular manner in which they sometimes seem to be affected by reagents.

It may be a matter of astonishment to some that no stress has been laid upon the radula in the comparison of different species. When the examination of the present collection was first commenced, drawings were made of this organ, and it was intended to publish and use them for diagnostic purposes, but it became evident in a short time that without a much more extended investigation than was possible under the circumstances no results of value could be hoped for. It appears that in almost every radula each row of teeth differs a little from the one preceding it, and very frequently five, six, or even more rows must be examined before a given form repeats itself; two rows of teeth from the same specimen will often differ as much as two from different species. From this it was evident that the majority of the figures hitherto published were valueless for comparative purposes, inasmuch as they show only one row of teeth, and it appeared wiser to defer the consideration of this particular organ, in the hope of making a thorough examination of the whole matter with larger material at some future date.

Class CEPHALOPODA, Cuvier.

Siphonopoda, Lankester.

Order I. DIBRANCHIATA, Owen.

Suborder I. OCTOPODA, Leach.

Division 1. Lioglossa, Lütken.

Family I. Pteroti, Reinhardt et Prosch.

Cirroteuthidæ, Keferstein.

Cirroteuthis, Eschricht.

Sciadephorus, Reinhardt et Prosch.
Bostrychoteuthis, Agassiz.

The history of this genus has been rather remarkable. Founded in 1836 by Eschricht for the reception of a single species, it underwent no enlargement for nearly fifty years, until, in fact, the dredgings of the "Talisman" gave Dr. Fischer materials for the description of a second species; whilst during the past year no less than five additional forms have been added, three obtained by the Challenger and two by the U.S. steamer "Albatross."

This sudden increase in our knowledge of the genus is coincident with the extensive prosecution of deep-sea dredging, and, as will be explained in the sequel (p. 231), furnishes one argument for regarding *Cirroteuthis* as an abyssal genus.

It is of course possible that some two or more of these forms may belong to the same species, for at present we have but slender means of ascertaining the amount of variation in this genus. As specific characters I have relied upon the form of the internal cartilage, the presence or absence of an "intermediate web," the position on the arm at which the cirri commence and cease, and the presence or absence of a tubercle or indurated tract at the junction of the web with the arms, which will be described further on.

Desiring to avoid as far as possible the danger of creating unnecessary species, I sent drawings and descriptions of those proposed to Dr. Paul Fischer for comparison with his type specimens, concerning which he writes,—"J'ai comparé avec soin vos figures avec les types de *Cirroteuthis umbellata*, et aucun d'eux ne se rapporte à mon espèce, dont

la terminaison des bras est differente, et dont les cirrhes sont beaucoup plus courts, et dont les nageoires sont aussi plus courtes et plus arrondies."

We have no reliable information as to the habits of the genus, and the Challenger material yielded none even as to its food, for several specimens were in such a fragmentary condition that no stomach was forthcoming, and in the other cases it was empty, and the intestine contained only a pulpy mass in which no structures could be distinguished. It may be conjectured that the enormous web serves as a kind of fishing-net, and that the cirri placed between the suckers are tactile in function. It seems also worth while to suggest that possibly the cirri may by their vibration create a current passing down the arms to the mouth, thus procuring a supply of food as is also the case with the Rotifer *Stephanoceros*. Unfortunately also not one of the specimens of *Cirroteuthis* collected by the Challenger is in a fit state for dissection, for the soft consistency of the tissues of these animals renders them exceedingly sensitive to reagents, and the amount of material to be dealt with on board the ship was so great that it was impossible to give to such delicate organisms the care they required. It is interesting to note, however, that no radula could be found, as is also the case in *Cirroteuthis müllleri*.

Cirroteuthis magna, Hoyle (Pl. XI. figs. 3–5; Pl. XII.; Pl. XIII. figs. 1–4).

1876. *Cirroteuthis* sp., Suhm, Challenger Briefe, vi., Zeitschr. f. wiss. Zool., Bd. xxvi. p. lxxx.
1885 „ *magna*, Hoyle, Diagnoses I., p. 233.
1885. „ „ Hoyle, Prelim. Rep. I., p. 109.

Habitat.—Station 146, between Prince Edward Island and the Crozets, December 29, 1873; lat. 46° 46′ S., long. 45° 31′ E.; 1375 fathoms; Globigerina ooze. One specimen.

Station 298, off Valparaiso, November 17, 1875; lat. 34° 7′ S., long. 73° 56′ W.; 2225 fathoms; blue mud. One mangled specimen.

The Body is oblong, about twice as long as broad, and rather broader than deep. The *mantle-opening* is circular, but little larger than the base of the siphon, and its margins are continuous with two ridges on the sides of the latter. *The siphon* is conical, and slightly swollen at the tip; it is not connected to the head by ligaments. The *fins* are obovate in form, about four times as broad as long, and thickened along the posterior margin. The *dorsal cartilage* (Pl. XIII. figs. 1, 2) is saddle-shaped, and elongated from side to side, not antero-posteriorly.

The Head is directly continuous with, and somewhat narrower than the body; the *eyes* are spheroidal, the lens spherical, and the palpebral opening circular.

The Arms are subequal, three and a half to four times as long as the body; they are slender, and more resemble thickenings of the web than independent arms; they are

thickest about two-thirds the distance from their base, and terminate in a delicate slender tip, which projects beyond the web. The *umbrella* is a thin delicate membrane, very largely developed, and when fully expanded probably forming a cup nearly three times as large in diameter as in depth. It extends from the tip of the ventral arm on either side backwards, and becomes gradually narrower, so that it only extends along the proximal two-thirds of the next arm, and passes beneath it to be attached in a crescentic line to the outer surface of the web, which similarly passes backwards from the tip of this (Pl. XII. fig. 1): this condition is usually described by saying that the arm does not lie in the umbrella for the proximal two-thirds of its length, but is joined to it by a vertical or "intermediate" web, but this does not so correctly represent the arrangement. The umbrella stretches across from tip to tip of the two dorsal arms, and between the proximal two-thirds of the two ventral arms (see woodcut 2). The web is thickened but not indurated where it is attached to the ventral aspect of the arms. The *suckers* commence about 1 cm. from the oral margin, and the first four lie pretty close together within a space of less than 2 cm., after which they gradually become further separated, an interval of 2–3 cm. intervening between each two; about two-thirds along the arm they stand closer together, and are very large, but after this they again become smaller, and stand in close contiguity with each other. The proximal suckers are small, prominent, and rather soft, and seem to contract by folding the lateral margins over towards each other, so as to present the appearance of a half-closed eyelid; the largest suckers are firm and muscular, and consist of a hollow globular basal portion imbedded in the arm and a short cylindrical or conical projecting portion. They are divided internally also into two parts, the outer being a shallow cup leading by a narrow aperture into a rounded cavity below. The *cirri* commence between the fourth and fifth suckers as very minute prominences, which gradually increase in length until halfway along the arm they attain a maximum length of 8 cm., after which they decrease rapidly, and cease opposite the attachment of the web to the ventral aspect of the arm.

The Surface of the body has been entirely denuded of epidermis, so that it is impossible to ascertain its nature; the web is perfectly smooth.

The Colour, so far as preserved, is a dull madder; an entry in v. Willemoes-Suhm's manuscript journal states that it was "rose" when captured.

The Jaws are shown in Pl. XII. figs. 6, 7.

Dimensions.

Length, total,	1155 mm.
End of body to mantle-margin,	163 „
End of body to eye,	175 „
Breadth of body,	125 „
Breadth of head,	about 100 „
Eye to root of fin,	126 „
Length of fin,	76 „
Breadth of fin (extreme),	513 „
Breadth of intermediate web,	180 „
Diameter of largest sucker,	8 „
Length of longest cirri,	80 „
Breadth of dorsal cartilage,	100 „
Length (greatest antero-posterior),	50 „
„ (median),	20 „
Thickness (dorso-ventral),	20 „

	Right.	Left.
Length of first arm,	875 mm.	875 mm.
Length of second arm,	870 „	875 „
Length of third arm,	870 „	890 „
Length of fourth arm,	838 „	915 „
Length of free tip of arms,	about 30 „	30 „
Suckers on first arm,	103 „	80 „
Suckers on second arm,	83 „	88 „
Suckers on third arm,	103 „	102 „
Suckers on fourth arm,	84 „	85 „

The species just described is based upon only two specimens; the smaller is in a very fragmentary condition, but the larger is of special interest as being, so far as I am aware, by far the largest of the genus hitherto known; the fine series of *Cirroteuthis mülleri* in the Copenhagen Museum contains none more than 40 cm. in extreme length.

Still larger dimensions must, however, be sometimes attained by the genus, as is proved by the suckers which were removed from a dead specimen floating on the surface, and which measured nearly twice as much in diameter as those of the present individual (see p. 66).

The arrangement of the web needs perhaps a little further description. Commencing with the portion between the two dorsal arms, it extends almost up to their extremities, only a very slender tapering portion projecting beyond it (Pl. XII. fig. 2, and woodcut 2). The arms themselves appear to be thickenings of the margin of the web for the reception of the suckers, rather than independent structures; they are about 25 mm. wide, thickened at the free margin where the suckers are inserted, and becoming gradually thinner as they pass into the web. A curved line (*i*, *i*, woodcut 2) may be seen passing along the membrane on either side from near the mouth to a point about two-thirds up the arm; this line is the attachment of the web extending between the dorsal and dorso-

lateral arms of either side, which is affixed to the outer surface of the web above described, and in its turn passes to within 30 mm. of the extremity of the dorso-lateral arm. Its margin is thickened where it is attached to the dorsal arm (Pl. XII. fig. 3); this thickening corresponds to the hardened tract forming this part of the margin of the web in *Cirroteuthis müller*i, but there is no trace of anything horny or cartilaginous in its constitution in the present species.

The membrane is attached in a precisely similar way to each two successive arms, producing, when looked at from the anterior end of the animal, the figure shown in woodcut 2, A.

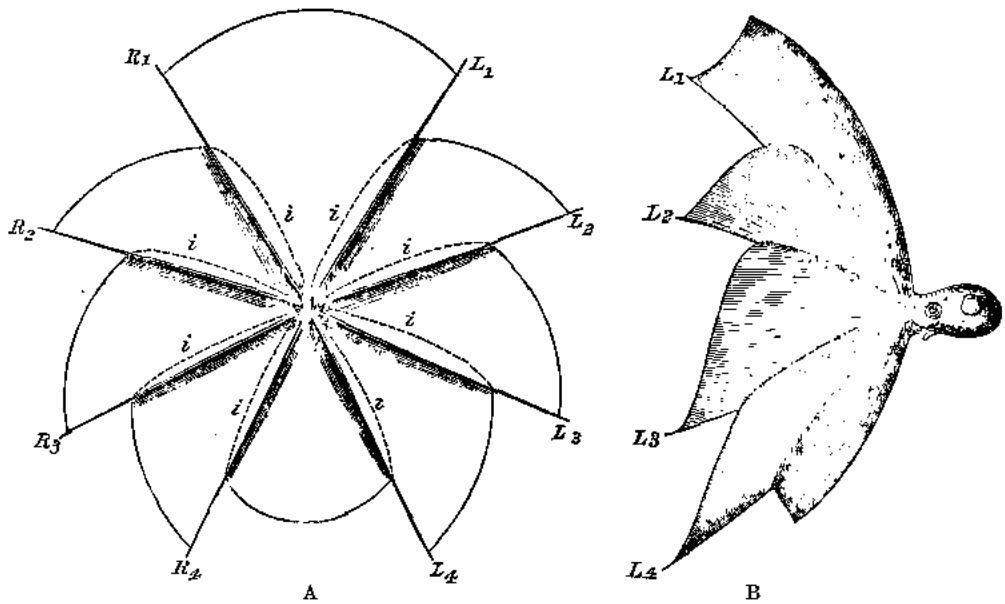

FIG. 2.—Diagrammatic figures of *Cirroteuthis magna*, drawn to a scale of about one-twentieth, to show the form and arrangement of the umbrella. A, seen from the anterior aspect; B, from the left hand side; R_1-R_4, L_1-L_4, the arms of the right and left sides respectively; *i*, *i*, the lines indicating the attachment of one web to the other.

The effect of this arrangement is that when the umbrella is extended the arms do not lie in its plane, but each is separated from it by the portion of web lying between the arm and the curved line alluded to above; this may be conveniently called the "intermediate" web.

Measurements of the different parts of the web led to the following conclusions as to its form when fully expanded. The perimeter of the margin must have been about 450 cm., the distance between the tips of the two dorsal arms being 80 cm., between the two ventral 62 cm., while the distances between the remaining pairs varied from 46 to 54 cm.

The radius of the circle in which the tips of the arms lie would thus be about 72 cm., and taking the average length of an arm at 87 cm., and assuming them to be quite extended or but slightly curved, the mouth would then be about 60 cm. behind the plane of the tips of the arms. The web itself, however, would form deep pouches between the

several arms owing to the presence of the intermediate web, and might render the whole apparatus a very effective fishing-net.

The dorsal cartilage (Pl. XIII. figs. 1, 2) may be described as saddle-shaped; it is narrow, thick, and rises up into a prominent angle on the dorsum, while the two sides are flattened out into obovate expansions, which are more prominent anteriorly than posteriorly. A thick semi-cartilaginous membrane is attached all round the dorsal surface, and appears to have been reflected over it, and thus to have enclosed a narrow cavity above the cartilage: in *Cirroteuthis mülleri* a similar membrane seems to have overlapped the posterior surface and to have formed a cavity there.[1] This organ is widely different in form from that of *Cirroteuthis mülleri* as may be seen at once on comparing Pl. XIII. figs. 1, 2, with the figures in Reinhardt and Prosch's Memoir. In both instances, however, the cartilage is entirely free from the sac in which it lies, and the bases of the fins rest upon it near the extremities of the lateral expansions.

The mangled specimen from Station 298 was at first referred to *Stauroteuthis*, but with very great hesitation; firstly because of its lacerated condition, and secondly in consequence of doubts as to the validity of the genus.

In Verrill's definition there are but few points mentioned which seem to me of generic importance, and of these a large proportion are also common to *Cirroteuthis*, for instance, the opening sentence—"Allied to *Cirrhoteuthis*, but with the mantle united to the head all around, and to the dorsal side of the slender siphon, which it surrounds like a close collar, leaving only a very narrow opening around the base of the siphon, laterally and ventrally"[2]—is quite misleading, and would not have been written if the author had had the opportunity of examining a specimen of *Cirroteuthis* in good condition, for he would then have seen that these characters, upon which he relies for distinction, are common to both genera; the mistake has no doubt arisen from his having had for comparison only the figures of Eschricht,[3] which exhibit the mantle as gaping widely open and exposing the gills; a condition only seen in specimens whose tissues have become loosened and stretched in consequence of defective preservation. The excellent drawing of the animal in a living condition by Madame Rudolph, published by Reinhardt and Prosch,[4] would have shown Professor Verrill the true state of the case, especially when taken in conjunction with their clear description of the arrangement:—"Head and body are united to the greatest extent possible, so that there only remains a horse-shoe-shaped aperture closely surrounding the funnel in the ventral median line" (*op. cit.*, p. 11).[5]

The points which are really diagnostic between the two genera, if only reliance can be placed upon them, are the following:—(1) "Dorsal cartilage forming a median

[1] Om Sciadephorus Mülleri, tab. iii. figs. 1, 2, 3.

[2] Ceph. N. E. Amer., p. 382.

[3] *Nova Acta Acad. Cæs. Leop.-Carol.*, tom. xviii., tab. xlviii.

[4] Om Sciadephorus Mülleri, tab. i.

[5] Professor Steenstrup, who gave Dr. Rudolph a preliminary acquaintance with the Mollusca of Greenland before his departure to that country, tells me that this account of the form of the mantle-opening was confirmed by Dr. and Madame Rudolph in conversation with him.

angle, directed backward,"[1] and (2) the fact that the web is attached to an equal extent both to the dorsal and ventral aspects of the arms.[2]

With regard to the former of these matters I am inclined to doubt its value, because in the case of *Cirroteuthis meangensis* I found a young individual with the cartilage disposed as in *Stauroteuthis*, while in a larger one it was placed in the usual manner. Furthermore, the examination of the specimens of *Cirroteuthis müllerí* in the Zoological Museum at Copenhagen led me to the conclusion that the cartilage was liable to considerable displacement by the unequal contraction of so soft and loosely compacted a body when immersed in alcohol, and that an observer who had only one specimen for investigation might easily be deceived as to its original position.

As to the latter point, it constitutes, to my mind, the chief diagnostic character of *Stauroteuthis*, if it be proved to exist. It may seem gratuitous to hint that so careful an observer as Professor Verrill may have made a mistake in such a matter as the attachment of the web to the arms, but he does not record the absence of the usual inequality, and it is a point which, unless exaggerated, as in the case of *Cirroteuthis magna*, is not very striking, and is also one which has been observed in every specimen examined with a view to ascertaining its existence. More explicit information as to this point, and as to the form of the internal cartilage, would be very acceptable to teuthologists.

The specimen under discussion was at first referred to *Stauroteuthis*, because, although the web was much lacerated, it appeared as though it could be traced almost to the extremities of the arms, and that name (with a query) was affixed to the drawing (Pl. XI. fig. 3), in which also the margin of the web was "restored" in agreement with this view as to the affinities of the animal. Since the cartilage has been extracted, however, and has been compared with that of *Cirroteuthis magna*, it has been found to present a most decided agreement with it (compare Pl. XIII. figs. 1, 2, and 3, 4), and a renewed examination of the arms and the fragments of the web has shown that the appearances previously relied upon were deceptive, so that there seems now every reason to regard this specimen and the larger one as conspecific.

Cirroteuthis pacifica, Hoyle (Pl. X.).

1885. *Cirroteuthis pacifica*, Hoyle, Diagnoses I., p. 235.
1885. „ „ Hoyle, Prelim. Rep. I., p. 112.

Habitat.—Station 181, off the south-eastern extremity of Papua, August 25, 1874; lat. 13° 50′ S., long. 151° 49′ E.; 2440 fathoms; red clay. One mutilated specimen.

The Body is almost entirely absent. The *fin* is obovate in form, and thickened along the posterior margin, thin and membranous at the extremity and along the anterior

[1] Ceph. N. E. Amer., p. 382.

[2] *Op. cit.*, pl. xxxii.

margin (fig. 3). The *mantle-opening* is horse-shoe-shaped, and closely embraces the base of the *siphon*, which is long, thin, and conical (fig. 3).

The Head is exceedingly short, and the *eye* appears to occupy all the available space between the fin and the arms.

The Arms are subequal, thick, rounded, and soft, and taper rapidly towards the extremities. The *umbrella* is attached directly to the arms, which are somewhat more prominent on its inner than on its outer surface; it is attached to the dorsal aspect of every arm almost to the tip, and to the ventral aspect for somewhat more than half its length, and at this latter attachment is a firm nodule of cartilaginous consistency (fig. 2). The *suckers* are about fifty-two in number, and commence close to the oral lip, and the first half-dozen stand near together; halfway up the arms they are farther apart, and the largest are situated opposite the attachment of the membrane to the ventral aspect of the arms; they are prominent, but not so hard and firm as those of *Cirroteuthis magna:* there are faint radial markings upon them. The *cirri* commence on the dorsal arms between the seventh and eighth suckers, and continue till the last; on the ventral arms they commence between the sixth and seventh, and here also are continued to the tips of the arms; they begin as small papillæ, and gradually increase in length, attaining the maximum about halfway along the arms.

The Surface is smooth.

The Colour is a deep purplish-madder, paler outside the umbrella and on the fin.

The Jaws are shown in Pl. X. figs. 4, 5.

Dimensions.

Length of fin,	15 mm.
Breadth of one fin from origin to tip,	55 „
Length of siphon,	15 „
Diameter of largest sucker,	2·5 „
Length of longest cirri,	5 „

	Right.	Left.
Length of first arm,	170 mm.	145 mm.
Length of second arm,	140 „	155 „
Length of third arm,	130 „	140 „
Length of fourth arm,	150 „	135 „

The only specimen representing this species is sadly mutilated; the whole body has been removed, leaving only one fin, one eye, and the siphon. It is readily distinguished from the last by the much greater thickness and solidity of the arms and the smaller comparative size of the suckers, and by the fact that the web is very narrow between the several arms, and does not admit of their being widely separated (this may be due to the action of the spirit); it is attached directly to each side of the arms, one web not being joined to the other so as to constitute an intermediate web. As in that form, however, it

passes to the tip of the arm on the dorsal aspect, and only about two-thirds up it on the ventral.

On the ventral side of each arm, just where the margin of the umbrella is attached, is a peculiar ovoid nodule of cartilaginous consistency projecting inwards, somewhat paler in colour than the surrounding tissue (see Pl. X. figs. 1, 2). This is obviously homologous with the thickening of the margin of the web in *Cirroteuthis mülleri*, alluded to above, and I have no doubt that it is of a similar nature to the structure described by Verrill in the case of his *Cirroteuthis megaptera*.[1] In that case, however, the organ seems to have been long and tentacular instead of being a mere nodule. I do not feel able to suggest any function for these structures, other than that they serve to strengthen the web at its attachment to the arm where it would naturally run the greatest risk of being torn. I do not think that their arrangement in this species lends any support to Verrill's view that "it may, perhaps, correspond to one of the transverse supports of the marginal membranes of *Sthenoteuthis* and *Ommastrephes*," but should rather be disposed to agree with Professor Steenstrup who regards them as comparable to the thickened margin of the web-like expansion of the third pair of arms of *Ommastrephes*. In any case it is interesting to see here a stage in the evolution of the more complete organ, which he has described, another step being represented by the still less pronounced nodule observed in the next species.

The proximal end of the cartilage of the fin was exposed and presented a long grooved articular surface; the one branchia which remained was similar to that of *Cirroteuthis mülleri*, presenting the appearance of a spheroidal nodule with meridional grooves, and looking not unlike an *Oniscus* when rolled up.

Cirroteuthis meangensis, Hoyle (Pl. IX. figs. 12, 13; Pl. XI. figs. 1, 2; Pl. XIII. figs. 5, 6).

1876. *Cirroteuthis* sp., Suhm, Challenger Briefe VI., Zeitschr. f. wiss. Zool., Bd. xxvi. p. lxxx.
1885. „ *meangensis*, Hoyle, Diagnoses I., p. 234.
1885. „ „ Hoyle, Prelim. Rep. I., p. 111.

Habitat.—Station 214, off the Meangis Islands, February 10, 1875; lat. 4° 33′ N., long. 127° 6′ E.; 500 fathoms; blue mud. One specimen.

Station 171, north of the Kermadec Islands, July 15, 1874; lat. 28° 33′ S., long. 177° 50′ W.; 600 fathoms; hard ground. One immature specimen.

The Body is much distorted, but appears to have been subglobular in form. The *mantle-opening* is very small, and fits closely around the base of the *siphon*, which is small and bluntly conical, with a still smaller pimple-like extremity; on either side there extends from the dorso-lateral base a curved fold of membrane, which loses itself in the

[1] Third Catal., p. 407.

mantle. The *fins* are about equal in length to the breadth of the body, narrow and pointed at the extremity, and thickened towards the posterior margin, and just above the root of each is a *pore* of unknown function. The *dorsal cartilage* is much elongated transversely, and is curved almost into the form of a horse-shoe (Pl. XIII. fig. 5).

The Head is exceedingly short, and the *eyes* large and spheroidal.

The Arms are subequal, and about three times as long as the body in the present shrunken condition of the specimen; they taper rather rapidly to slender points. The *umbrella* extends on the dorsal side of each arm to within 1 cm. of its extremity, whilst on the ventral side it reaches only four-fifths along it; the arms lie in the umbrella, and are not united to it by any intermediate or vertical web. The *suckers* are about sixty to seventy in number, small and subequal; they are at equal intervals for the greater part of the arm, but closer near the extremity. The *cirri* are short, stout, and conical, the largest 2 mm. in length; on the ventral arms they commence between the fourth and fifth suckers, and extend to the fiftieth sucker, beyond which there are twenty-one suckers, which gradually decrease; on the dorsal arms the cirri commence between the sixth and seventh suckers, and continue to the fifty-fifth, beyond which there are nine suckers.

The Surface is smooth.

The Colour of the body is creamy white, of the arms and umbrella deep madder-brown. The suckers and cirri are paler.

Dimensions.

Breadth of body,	30 mm.
Length of fin,	10 „
Breadth of one fin,	30 „
Diameter of largest sucker,	1 „
Diameter of eye,	12 „

	Right.	Left.
Length of first arm,	100 mm.	100 mm.
Length of second arm,	94 „	100 „
Length of third arm,	80 „	92 „
Length of fourth arm,	90 „	92 „

This species is closely allied to the last, the web being attached directly to either side of each arm, so that there is no intermediate web, whilst it passes nearly to the tip on the dorsal but only about four-fifths upon the ventral aspect; furthermore, at the junction with the arm on this side there is a small papilla, but this, besides being smaller, is more intimately connected with the arm, and lies less in the web than in the case of *Cirroteuthis pacifica;* it is marked by a ridge which is a continuation of the margin of the umbrella (Pl. XI. fig. 2); the cirri too, instead of ceasing where the membrane terminates on the ventral aspect of the arm, are continued almost, if not quite, to its extremity. The two species differ in the form of the funnel, in the presence of the pore above mentioned, and the cirri

commence one or two suckers farther from the mouth, but it is not certain how much importance is to be attached to this point.

In connection with the capture of this species I find the following note in Dr. v. Willemoes-Suhm's MS. Journal. "Cirroteuthis.—By us this genus . . . . has been found before in deep water several times, especially in the Antarctic," alluding no doubt to the specimens above described as *Cirroteuthis magna* and *Cirroteuthis pacifica*. Furthermore, in his "Challenger Briefe" (*loc. cit.*) he remarks, "Ich möchte glauben, dass das Thier wie die Umbellularia im hohen Norden das Flachwasser erreicht, ... im übrigen aber überall in grossen Tiefen bei niedrigen Temperaturgraden anzutreffen ist," a supposition which we shall afterwards see to be remarkably borne out by all we know of the distribution of the genus (see section on Distribution, *postèa*).

The dorsal cartilage (Pl. XIII. figs. 5, 6) resembles that of *Cirroteuthis magna* rather than of *Cirroteuthis mülleri*, but the peculiar transversely elongated and curved shape of the former is here greatly exaggerated. It consists, indeed, of a thin rod bent round almost into the shape of a horse-shoe: the inner surface of the curve is rounded off, whereas the outer is flat except for four little angular processes, which protrude from it on the anterior and posterior edges about halfway between the centre and the extremities of the curve. Just outside these processes is a slightly flattened area which receives the base of the fin, and forms a kind of socket for it.

The interesting little specimen shown enlarged about four diameters on Pl. IX. figs. 12, 13, may, owing to its complete state of preservation, be supposed to give a better idea of the general form of the body than any other in the collection.

The arms are bent sharply outwards, probably owing to the contraction caused by the alcohol, and for the same reason, as well as because the web on their dorsal side extends quite to the tips, they are drawn upwards at their extremities. They have each about thirty suckers, and the cirri appear as minute papillæ beside and alternating with them.

The head measured across the eyes is the widest part of the body, and just behind these, and slightly to the ventral side of them, are the fins, which arise by narrow rounded peduncles, and become flattened and expanded distally. The funnel is placed anteriorly to the eyes and curves downwards, the mantle-margin fitting closely round its base.

The posterior extremity of the body presents several interesting points for consideration: it is flattened from above downwards, thus terminating in a subacute edge, and this marginal portion seems to consist entirely of the internal cartilage with the integuments stretched tightly over it. The form of the skeleton thus revealed very closely resembles that of *Cirroteuthis meangensis* above described, the angular prominences shown in Pl. XIII. fig. 5, being quite distinctly traceable (they are not quite sufficiently indicated in Pl. IX. fig. 12). It is very singular that this cartilage is curved in the

horizontal plane in which lies the longitudinal axis of the body, whereas in the specimen which I take to be an adult of the same species, it lies in a vertical plane. The significance of this point has been already alluded to whilst discussing the genus *Stauroteuthis* (p. 61).

This specimen has been referred to *Cirroteuthis meangensis*, chiefly on account of the dorsal cartilage, but partly also from the presence of papillæ at the junction of the web with the ventral aspect of the arms, though this character would not distinguish it from *Cirroteuthis pacifica*.

Cirroteuthis sp. (Pl. IX. figs. 10, 11).

Habitat.—South Pacific Ocean, 20° W. of Patagonia, November 6, 1875.

Concerning this specimen, Mr. Murray's MS. journal has the following note:—"On the 6th we passed a large blubber. The dingy was lowered, and I went away in it to pick it up. It turned out to be part of an immense cuttle-fish, *Cirroteuthis*. The body was gone as it had been eaten by some animal, only the arms and mouth parts remained."

The portions which came into my hands consisted of three suckers, one of which had a small fragment of the integument of the arm attached to it (fig. 10). There is nothing to indicate from what part of the arm they were taken, but it is most likely that the largest suckers available would be selected for removal, and on the assumption that such was the case they would show that the animal was of considerably greater dimensions than the specimen of *Cirroteuthis magna*. In that form the largest suckers are situated about two-thirds along the arms, and measure 8 mm. in diameter, while the largest of the present three was about 12 mm. in diameter; it would be unsafe to assume that all the dimensions of the animals were proportional to the diameters of the suckers, but it seems fair to suppose that this specimen attained a length of not less than 1·5 metres.

A section of one of the suckers shows it to consist of a firm muscular shell, which is embedded in the substance of the arm, and is somewhat less than 1 mm. thick. The cavity is subdivided by a circular ridge, the outer portion being the proper suctorial disk, the margins of which are in this instance incurved, so that it appears to form part of the general cavity.

The suckers present no characteristic structure nor peculiar markings which could serve to establish satisfactorily either the specific identity of this form with, or its difference from, any of the preceding ones.

Family II. AMPHITRETIDÆ, n. fam.

Amphitretus,[1] Hoyle.

This genus possesses the character, unique amongst Cephalopoda, of having the mantle fused with the siphon in the median line, so that there are two openings into the branchial cavity, one on either side, whence the name.[2] Since only one species is at present known, it is unnecessary to give a more detailed generic diagnosis.

Amphitretus pelagicus, Hoyle (Pl. IX. figs. 7–9).

1885. *Amphitretus pelagicus*, Hoyle, Diagnoses I., p. 235.
1885. „ „ Hoyle, Narr. Chall. Exp., vol. i. p. 271, fig. 106.
1885. „ „ Hoyle, Prelim. Rep. I., p. 113, woodcut.

Habitat.—Station 170, off the Kermadec Islands, July 14, 1874; lat. 29° 55′ S., long. 178° 14′ W.; 520 fathoms; volcanic mud. One specimen, sex (?).

The Body is short, rounded, of gelatinous consistency, and semitransparent. The *mantle* adheres to the sides of the siphon, so that the *mantle-opening*, which is single in all other known Cephalopods, is here divided into two pocket-like openings, which lie one beneath each eye, and extend less than halfway to the *siphon*, which is very long and narrow, and extends forwards anteriorly to the margin of the mantle, for a distance almost equal to the length of the body, and is a little swollen at the extremity.

The Head is indistinguishable from the body, except by the possession of the *eyes*, which are situated near together on the dorsal surface; they consist of a larger basal spheroid, through the walls of which pigment is clearly visible, upon which stands a smaller very prominent spheroid, white, opaque, and of glistening surface.

The Arms are equal, and rather more than twice as long as the body; they are slender, and taper at first gradually and then more rapidly to comparatively blunt points. The *umbrella* extends more than two-thirds up the arms, and is thin, delicate, and transparent (much damaged in the present instance). The *suckers* are firm, muscular cups embedded in the softer tissue of the arms, as in *Cirroteuthis*; there are about twelve placed at some distance apart on that portion of the arm up which the web extends, and eleven closely set, and showing a tendency to biserial arrangement on the free extremities. There are no *cirri*, nor is there any trace of the formation of a *hectocotylus*.

[1] ἀμφίτρητος, with double entrance.

[2] Functionally, if not structurally, this arrangement may be compared with the median septum which is found in the branchial cavity of *Octopus*, *Eledone* and other genera, and is seen carried almost to the margin of the mantle in *Alloposus mollis*, Verrill (Ceph. N. E. Amer., pl. 1. figs. 1, 2).

The Surface appears to have been quite smooth originally; there is no sign of any cirri or warts.

The Colour is a dull yellow, apparently due to preservation in picric acid, and the mantle and umbrella are thickly sprinkled with small brown chromatophores.

Dimensions.

Length, total,	45	mm.
End of body to mantle-margin,	11	„
End of body to eye,	9	„
Breadth of body,	11	„
Eye to edge of umbrella,	30	„
Diameter of largest sucker,	0·75	„
Length of arms,	30	„

This interesting little Cephalopod came into my hands in a condition of strong contraction, due to the action of strong spirit and of picric acid, in which I infer that it had been placed, partly from its strong yellow colour and partly from a statement in one of v. Willemoes-Suhm's letters to the effect that this reagent was commonly used on board for small Cephalopoda.[1] The body of the animal was much deformed owing to this contraction, and it was only after prolonged soaking in weak spirit that it was possible to make out the principal points in its organisation; indeed, it was long before I discovered the two lateral openings into the mantle cavity, supposing in consequence that this communicated with the exterior only by the siphon. There seems still to be an adhesion on one side between the mantle and the body, so that access into the branchial cavity on this side is impossible; it is so clear, however, on the other that it seems only reasonable to suppose that this closure is an abnormal condition.

As regards the affinities of the genus, it seems to be most nearly allied to *Cirroteuthis*, as shown by its arms bearing a single series of suckers and being united by a broad web. They resemble each other too in the great extent to which the mantle is united with the head, but in the one case the adhesion is lateral, in the other it is median.

As conspicuous points of difference may be noted, the absence of the cartilage (so far as can be ascertained by feeling through the body-wall), the absence of fins and of cirri along the arms.

In the delicacy and transparency of its tissues it also resembles *Bobitæna Eledonella* and *Japetella*, but this may be an adaptation to pelagic life rather than a point indicating morphological relationship.

[1] "Für Cephalopoden zarterer Art verwenden wir stets mit gutem Erfolg, ehe wir sie in Alkohol thun, eine verdünnte Lösung von Chrom- oder, bei kleineren, namentlich durchsichtigen Arten, Pikrinsäure," Challenger Briefe VI., *Zeitschr. f. wiss. Zool.*, Bd. xxvi. p. lxxx, 1876. I may take this opportunity of recommending others to avoid the use of this reagent for Cephalopoda.

Family III. ARGONAUTIDÆ, Cantraine.

Argonauta, Linné.

Argonauta argo, Linné.

1758. *Argonauta argo*, Linn., Syst. Nat., ed. x. p. 708.
1817. „ *haustrum*, Dillwyn, Descr. Catal., p. 335 (=*forma aurita*).
1838. „ *argo*, d'Orb., Céph. acét.; Argonaute, pl. ii. figs. 1, 2.
1852. „ *Gruneri*, Dunker, Zeitschr. f. Malak., p. 48 (=*forma mutica*).
1861. „ „ Reeve, Conch. Icon., pl. iii. fig. 2*b* (=*forma mutica*).
1861. „ *argo*, Reeve, Conch. Icon., pl. iii. fig. 2*c*.
1861. „ *haustrum*, Reeve, Conch. Icon., pl. ii. (=*forma aurita*).

Habitat.—Cape of Good Hope, December 1873. One medium sized specimen.

Atlantic, Cape of Good Hope (d'Orbigny, Tryon); Madeira (Suhm, MS.); Mediterranean (d'Orbigny, Cantraine, Vérany, &c.); east coast of the United States (Lockwood, Verrill); Pacific and Gulf of California (Tryon).

The specimen brought home by the Challenger measures 90 mm. in length, and is of special interest because it shows the process of repair. On the right hand side a large crack has run across the shell from a point about 10 mm. from the inner cusp to about midway along the convex curve; at its commencement this expands into a notch 18 mm. across and 11 mm. deep, while farther back it leads into a hole in the form of an isosceles triangle whose sides are 25 mm. and whose base is 18 mm. It passes also quite across the carina of the shell, and about 15 mm. on to the left side. Besides this crack there are two irregularly oval holes, each about 10 mm. long on the left side, a small one on the right, and two on the carina.

Repair has proceeded to such an extent that the notch is almost filled up, and from a consideration of the lines in the calcareous matter deposited this seems to have taken place while from 3 to 5 mm. were being added to the rest of the margin. The large triangular hole has been quite filled, though the layer covering it is somewhat thinner than the remainder of the shell; and the smaller holes are partially or completely filled by an exceedingly delicate membrane, so thin as to be quite flexible, and bearing a strong superficial resemblance to goldbeaters' skin.

Assuming that the injuries were all inflicted at one time, this would indicate that the most important lesions were most rapidly repaired. Another matter deserving of special notice is that the material which has filled up the marginal notch is quite different from that which has been employed in repairing the holes. The former is perfectly smooth, shining, and porcellanous, and marked with striæ parallel to the margin, while the latter is dull, rough, and irregularly scratched, one or two lines describing elliptic curves; this latter substance, moreover, seems to rise up from the under surface of the shell, for

while it is evenly continuous with the inner surface it does not rise up quite so high as the outer, leaving the rough angles exposed. The two materials meet in a distinct line near the bottom of the notch.

This confirms what has been stated by previous observers, that the processes of repair are differently carried out in the marginal and central parts of the shell.

Family IV. PHILONEXIDÆ, d'Orbigny.

Tremoctopus, Delle Chiaje.

Philonexis, d'Orbigny.

Tremoctopus quoyanus (d'Orbigny), Steenstrup (Pl. XIII. fig. 7).

1835. *Octopus* (*Philonexis*) *Quoyanus*, d'Orb., Amér. mérid., p. 17, pl. ii. figs. 6–8.
1838. *Philonexis Quoyanus*, d'Orb., Céph. acét., p. 96; Poulpes, pl. xvi. figs. 6–8, pl. xxiii. fig. 5.
1861. *Tremoctopus Quoyanus*, Stp., Vid. Meddel. nat. Foren. Kjøbenhavn, Aar 1860, p. 332.

Habitat.—North Atlantic, April 28, 1876; lat. 17° 47′ N., long. 28° 28′ W. (at noon); from the tow-net at night; surface. Seventeen specimens (8 ♀, 9 ♂).

South Pacific, between the Sandwich Islands and Tahiti, September 15, 1875; lat. 12° 8′ S., long. 150° 13′ W. One specimen, ♂.

South Atlantic (d'Orb.); Atlantic (Stp.).

Of the seventeen specimens from the Atlantic above recorded, the three largest were in a separate bottle labelled "in absolute alcohol," while a fourth was mounted in a cell as a microscopic object, but, owing to the impossibility of identification in that condition, it was transferred to a tube of alcohol.

All the males had the hectocotylised arm (the third on the right side) still enclosed in its sac, which had the form of a large tumour extending as far as the margin of the mouth; and in one case there were six suckers upon its inner surface close to the margin of the mouth, belonging to the arm which was just issuing from its sac, an interesting fact as showing that the sac opens first at its oral margin (Pl. XIII. fig. 7).

The specimen from the Pacific Ocean was not very well preserved, the web between the arms having been almost entirely destroyed, so that error in its identification is by no means impossible.

The largest female specimen obtained was so much larger than those measured by d'Orbigny that it seems worth while to record its principal dimensions; it does not appear to be sexually mature, and Professor Steenstrup informs me that he has never seen any individual in that condition.

Dimensions.

Length, total,	70 mm.
End of body to mantle-margin,	12 „
End of body to eye,	18 „
Breadth of body,	16 „
Breadth of head (including the eyes),	16 „
Diameter of largest sucker,	0·75 „

	Right.	Left.
Length of first arm,	50 mm.	45 mm.
Length of second arm,	45 „	52·5 „
Length of third arm,	17·5 „	20 „
Length of fourth arm,	32·5 „	27·5 „

Tremoctopus atlanticus (d'Orbigny), Steenstrup.

1835. *Octopus (Philonexis) atlanticus*, d'Orb., Amér. mérid., p. 19, pl. ii. figs. 1–4.
1838. *Philonexis atlanticus*, d'Orb., Céph. acét., p. 98; Poulpes, pl. xvi. figs. 4, 5.

Habitat.—North Atlantic between Tenerife and St. Thomas, Danish West Indies; surface. Fourteen specimens (6 ♀, 8 ♂).

Tropical Atlantic (d'Orb.).

The male specimens from the North Atlantic present a very interesting series of graduated sizes, illustrating the gradual development of the hectocotylus. The smallest had a mantle of 2·5 mm. in length, the position of the third right arm was occupied by a small round process, of about 0·75 mm. in diameter; in another, where the mantle was about 3 mm. in length, the hectocotylus was 1·5 mm. in diameter, while a third, with a mantle 4·5 mm. long, had a hectocotylus 2·5 mm. in diameter.

Tremoctopus gracilis (?) (Eydoux et Souleyet), Tryon (Pl. XIII. figs. 8, 9).

1852. *Octopus gracilis*, E. et S., Voy. "Bonite," p. 13, pl. i. figs. 8, 9.
1879. *Tremoctopus gracilis*, Tryon, Man. Conch., vol. i. p. 131.

Habitat.—Western Pacific, between Papua and Japan; surface. One specimen, ♂. North Pacific, lat. 8° N., long. 106° W. (E. and S.).

I cannot with satisfaction refer this specimen to any of the known species of *Tremoctopus*, but it appears to agree fairly with the form described by the naturalists of the "Bonite," although their diagnosis is by no means so complete as might have been wished. In the present case the most striking peculiarity is in the formation of the hectocotylus, and that perhaps they had no opportunity of observing.

The third right arm is as usual absent, but instead of its place being occupied by a round sac, there is seen beneath the skin a narrow white thread disposed in an elliptic

spiral of one and a half turns (Pl. XIII. fig. 8). The thread was removed from its sac and was then seen to present the form depicted in fig. 9. It is about 12 mm. in length, and there is a swelling near one end of it (fig. 9, *a*) which is evidently the rudiment of the "pyriform portion" or capsule figured by Steenstrup in *Tremoctopus quoyanus*, and by Vérany in several Mediterranean species;[1] while the more slender continuation of the arm is evidently the filament of other forms. One side of it bears two series of minute suckers, as far as the swelling above mentioned. There is nothing to indicate that the adult hectocotylus would differ materially from that of other species, but in the other young forms which I have seen, it has been developed in a small globular swelling, and not laid out flat under the skin.

As regards other specific characters, the dorsal arms are about twice the length of the mantle and a little longer than the second pair; the ventral arms are about as long as the mantle and nearly twice as long as the third pair. There is a pair of aquiferous pores on the top of the head, and another pair situated one on either side of the siphon; the eyes are large and spheroidal, but do not present the pedunculate appearance seen in Eydoux and Souleyet's figure.

Family V. Alloposidæ, Verrill.

Alloposus, Verrill.

Haliphron (*?*), Steenstrup.

Alloposus mollis, Verrill.

1861. *Haliphron atlanticus* (*?*), Stp., Vid. Meddel. nat. Foren. Kjøbenhavn, Aar 1860, p. 333.
1880. *Alloposus mollis*, Vll., Amer. Journ. Sci. and Arts, vol. xx. p. 394.
1881. „ „ Vll., Ceph. N. E. Amer., pp. 366, 420, pls. l., li. figs. 3, 4.
1884. „ „ Vll., Second Catal., p. 247.

Habitat.—North Atlantic. Two fragments of a dead specimen.

Off Newport, Rhode Island, 238 to 506 fathoms; off Chesapeake Bay, 300 fathoms; off Delaware Bay, 197 fathoms; off Martha's Vineyard, 310 to 715 fathoms; south of Nantucket Island, U.S.A., 1346, 1735 and 1731 fathoms (Verrill).

A bottle labelled "Part of a mutilated cuttle-fish picked up at sea. North Atlantic," came into my hands among the collection: it contained part of the interbrachial web near the mouth and a portion of an arm.

The web measures about 16 cm. in its greatest diameter, and contains portions of

[1] Hectocotyl., p. 208, pl. ii. fig. 8*a*; Céph. médit., pl. xli. I may here correct a mistake in Mr. Dallas' rendering of Steenstrup's paper (*Ann. and Mag. Nat. Hist.*, ser. 2, vol. xx., 1857); on p. 104, line 33, for "although this" read "and it." The mistake may have arisen through the English version having been taken from a German one and not directly from the Danish.

four arms, of which the longest is about 14 cm. long, and contains six suckers. The innermost of these, judging from the way in which the arms slope towards each other, must have been either that nearest the mouth or the second one; it is about 1 cm. in diameter, while the distal one on the fragment measures 1·5 cm. The suckers consist of hollow muscular bulbs like those of *Cirroteuthis*, embedded in the comparatively loose tissues of the arm, but the ridge marking off the true cavity from the suctorial disk is less marked, and the interior seems to have been lined by a kind of cuticle, which remains as a softened mass within it. The stellate form of the aperture, so distinctly marked in Verrill's figure of the hectocotylised arm (*op. cit.*, pl. li. fig. 4) is seen to some extent here, though the rays of the star are more numerous and much less prominent. The web itself is thick, tough, and very much wrinkled, and forms two or more circular folds around each sucker.

The portion of the arm is 12 cm. long and elliptical in section, the axes of the ellipse being 4·5 cm. and 7 cm. respectively. It seems to consist of a cylindrical core 3 cm. in diameter, composed of a gelatinous material containing numerous muscle-fibres embedded in it: around this is a quantity of connective tissue. Only on the inner aspect of the arm is any integument preserved; this is precisely similar in character to that surrounding the mouth, and contains four suckers, which are about 12 mm. in diameter and 3·5 cm. apart (measuring from centre to centre); they are arranged in a slightly wavy line.

The fragments above described agree so well in every particular with Professor Verrill's graphic description of his *Alloposus mollis*, that there can be no doubt they belong to that species.

When in Copenhagen the year before last, Professor Steenstrup showed me the type specimen of his *Haliphron atlanticus*, and I was at once struck by its remarkable resemblance to the hectocotylised arm of *Alloposus* as depicted by Verrill. The specimen is in fact a portion of an arm some 5 or 6 cm. in length, with two rows of very prominent beehive-shaped suckers, the apertures of which are markedly stellate in form.[1] Unfortunately the specimen has been somewhat macerated, having been found in the stomach of a shark, and no trace remains of the fringe of slender processes which forms such a conspicuous character in *Alloposus*.

Steenstrup's name was published nearly twenty years before Verrill's, and, in the event of the identity of the two genera being conclusively proved, must take precedence. The possibility must not be overlooked that the two forms may be two distinct species belonging to the same genus.

[1] The original description characterises the species by the resemblance of the lobate suckers to the half-opened flowers of the lily of the valley, *Convallaria majalis*, Stp., *op. cit.*, p. 332.

Family VI. Octopodidæ, d'Orbigny (*em.*).

Octopidæ, d'Orbigny.

The subdivision of the Octopoda into smaller groups presents considerable difficulties: Steenstrup and others following him have characterised two considerable groups, according as the suckers are in a single or in several series,[1] but the importance of this character seems to me overrated. In the first place, the character is one rather of degree than of kind, as may be readily seen from the facts that the proximal suckers in the arm of an *Octopus* are almost always arranged in a single series, and that the number of suckers so disposed is greater or less according as the arm is bent outwards or inwards. This circumstance and the arrangement of the suckers, not opposite in pairs but in a zigzag line, at once suggest that the two modes of disposition may pass one into the other (see also pp. 76, 78).

Furthermore, glancing at the results of this method of classification, it is seen that *Eledone* and *Octopus* are separated from each other, and that the former is united with *Cirroteuthis* and the latter with *Tremoctopus* and *Argonauta*. It is not necessary to recapitulate the points of likeness between the first two genera nor those in which they severally differ from the forms with which they are thus brought into contact. Indeed, I do not for the present feel disposed to place *Octopus* and *Eledone* in separate families at all, the only conspicuous internal difference between them being that in the latter the eggs are attached each by a separate stalk to the wall of the ovary.[2] If it were necessary to break up the Octopodidæ, I should propose rather to separate from them the soft semi-gelatinous forms, such as *Bolitæna* and *Japetella*, which in this peculiar constitution of their bodies resemble the Alloposidæ and Cirroteuthidæ (though this may indicate merely analogy not homology), but our knowledge of them is at present too fragmentary to render such a course advisable.

Octopus, Lamarck.

This genus continues much the same in general scope as when defined by Lamarck, the only considerable loss it has sustained being the removal of the genus *Eledone*.

There is perhaps no other group which presents so many difficulties to the systematist, for no two authorities seem agreed as to the characters which are to be relied upon for the purpose of defining species; it will therefore be advisable to say a few words regarding the principles which have been followed in the present Report.

The general form and proportions of the body are of some value, though not of much, for the whole consistency is soft, there is no firm internal skeleton to aid in giving a determinate outline, and any one who has watched a living *Octopus* and seen the mantle

[1] Overblik, p. 69; Fischer, Man. de Conch., p. 331.

[2] Grant, *Edin. New Phil. Journ.*, vol. ii. p. 317, 1827; and Brock, *Morphol. Jahrb.*, Bd. vi. pp. 283, 284, 1880.

alternately distending and contracting with the respiratory movements, will easily understand how variations in form may arise. Nevertheless, when a number of specimens of the same species are compared which have been subjected to pretty much the same treatment, a certain similarity is usually to be remarked among them.

The relative length of the arms, both with respect to each other and to the body, was regarded by d'Orbigny as a point of the greatest importance, and although it has again and again been shown that he greatly exaggerated this,[1] nevertheless he has been followed by many authorities, such as Gray and Tryon. The arms of an *Octopus* being almost wholly muscular, and entirely devoid of any hard or even cartilaginous parts whatsoever, are capable of a very considerable degree of contraction and extension, and as, when killed by being placed in fresh water or alcohol or poisonous solutions, they twist their arms about in the most lively manner, it follows that they may die with them in very varied states of contraction. There are, of course, cases in which the dimensions of one or more pairs of arms are so preponderant that no hypothesis of irregular contraction will account for the difference, which must then be regarded as a matter of systematic importance; such instances are to be seen in *Octopus macropus*, Risso, where the first pair, and in *Octopus aranea*, d'Orbigny, where the fourth pair of arms greatly exceed the others. When, however, d'Orbigny places his *Octopus fontanianus* in the division "Bras inférieurs les plus longs," because the length of the upper arms is 165 mm. and of the lower 166 mm., he carries out the principle to an extent which is almost too ridiculous to require criticism.

The degree to which the arms are united by a web or umbrella is a valuable character, though it must be borne in mind that here, as in the case of the arms, small variations must be regarded as probably due to different degrees of contraction.

The colour has commonly been regarded as of but little systematic value, owing to the manifold variations in this respect which these animals undergo owing to the play of the chromatophores. It seems, however, reasonable to suppose that in animals which have been killed and preserved in the same way, the chromatophores will be similarly affected, and thus the differences which are due to their action eliminated. Certainly in examining the Challenger material I have remarked that specimens which seemed on other grounds to be referable to the same species have generally agreed also in regard to colour. There are some cases (*e.g.*, *Octopus pictus*, Brock, and *Octopus lunulatus*, Quoy and Gaimard) in which the colour is disposed in definite bands or patches, and in these its distribution is quite diagnostic.

The nature of the surface of the body, namely, whether smooth or provided with warts or cirri, is also regarded by d'Orbigny with disfavour, on the ground that variations in this respect occur in correlation with the position and state of irritation or repose of the animal. The remarks just made regarding the colour apply to a large extent here

[1] See Verrill, Ceph. N. E. Amer., p. 381, and pp. 86, 93, 100 of the present Report.

also; the warts and cirri certainly vary according to the mode of preservation, but they are rarely so masked as not to be perceptible on careful examination. The matter is still open to question, however, and any one who can readily obtain numbers of fresh specimens would do a good work by killing and preserving them in different ways and reporting upon the variations thus produced in their surface markings.

A character which has been much used by some authors, Gray for instance, is the fact that a certain number of the proximal cups are often arranged in a single series. This, I feel convinced, is of very little importance; the statement that the suckers in the genus *Octopus* are in two series is not, strictly speaking, correct, they are placed in a zigzag so close that they often appear to form a succession of pairs, but when the arm is extended (bent away from the mouth) the proximal portion of the zigzag is stretched out and the suckers fall into a more or less nearly straight line, on the other hand, when the arm is flexed (towards the mouth) the zigzag closes up and the two series reappear. The presence or absence of certain large suckers on the lateral arms, used by d'Orbigny, and by Gray and Tryon following him, for specific diagnosis, has long since been shown by Steenstrup to be merely a sexual character.

To sum up, then, I have paid some attention to the form and proportions of the body, not much to variations in the lengths of the arms (unless these were considerable), some to the colour, and a good deal to the nature of the surface of the body.

Any peculiarities that presented themselves in the suckers have, of course been noted, and the same is the case with the hectocotylised arm whenever this was present.

Of this last structure I have observed what seem to be three fairly distinct types:—

1. That found in *Octopus vulgaris*, *Octopus marmoratus* (Pl. VI. figs. 2, 3), &c., where the modified extremity is minute in relation to the arm; it is conical, or rather pyramidal, and has a narrow groove on the inner side.

2. The form seen in *Octopus levis* (Pl. II. fig. 2), *Octopus januarii* (Pl. VII. fig. 2), &c., which resembles the last in form, but is decidedly more bulky and conspicuous. It shows a tendency to develop transverse ridges on the interior of the spoon-shaped termination, and reaches its extreme form in *Octopus obesus*, Verrill.[1]

3. The form which has only been found, so far as I am aware, in *Octopus punctatus*, Gabb. (see Pl. V. fig. 2). It is slender and very long in proportion to the arm, being nearly one-tenth of its total length in the Challenger specimen.

There is a temptation to break up the large genus *Octopus* into groups based upon characters derived from this organ, but I have been unable at present to ascertain that they are correlated with other distinctions between the different forms, and it may prove impossible to keep these three types separate when the structure of the hectocotylised arm shall become known in a greater number of species than is at present the case.

[1] See Ceph. N. E. Amer., pl. xxxvi. fig. 4.

Octopus occidentalis, Steenstrup, MS.

... *Octopus occidentalis*, Steenstrup, MS. in Mus. Havn.
1853. „ *vulgaris*, var. *americanus*, d'Orb., Moll. Cuba, p. 14, tab. i.

Habitat.—Ascension, April 1876. One specimen ♀.
Cuba (d'Orb).

The Body is short and oblong, somewhat expanded behind, and deeply grooved in the middle line. The *mantle-opening* terminates midway between the eyes and the *siphon*, which is conical, pointed and of quite the average length, extending fully half-way to the umbrella-margin.

The Head is very short and as broad as the body, the *eyes* being very prominent and the eyelids much contracted.

The Arms are subequal, about six times the length of the body. The *umbrella* extends nearly one-third up the arms, to the least extent apparently between the dorsal pair, though this may be owing to the state of contraction. The *suckers* are of moderate size, but present no characteristic peculiarities. The *circumoral lip* is invisible, owing to its retraction, the suckers extending quite to the centre.

The Surface is rough, slightly so on the body, but with minute irregular papillæ scattered over the head and the outer surfaces of the arms. The internal surface of the umbrella bears very numerous papillæ, which are aggregated into clusters, between which the skin is smooth; they extend over the inner surface of the arms between the suckers, and the wall of these bears minute warts on its outer surface. There are traces of one or two irregular cirri over each eye, but none can be found on the back.

The Colour of the upper surface of the body, head, and outside of the arms is dark brown, almost black, the ventral surface of the body being amber-brown; the inner surface of the umbrella is pale yellow, the groups of papillæ being still of a pinkish hue, though not so deeply coloured as in d'Orbigny's figure (*loc. cit.*), which was perhaps drawn from life.

Dimensions.

Length, total,	300 mm.
End of body to mantle margin,	35 „
End of body to eye,	55 „
Breadth of body,	50 „
Breadth of head,	40 „
Eye to edge of umbrella,	about 50 „
Diameter of largest sucker,	7 „

	Right.	Left.
Length of first arm,	235 mm.	120[1] mm.
Length of second arm,	235 „	240 „
Length of third arm,	230 „	230 „
Length of fourth arm,	220 „	230 „

[1] Mutilated. The lengths of the arms are measured from the margin of the mouth.

There can be no doubt that this specimen is to be referred to the same species as that figured by d'Orbigny (*tab. cit.*), but there is much more difficulty in deciding by what name it should be called. When the plates accompanying the "Cuba Memoir" were drawn it is evident that d'Orbigny regarded it as varietally distinct from *Octopus vulgaris*, Lmk., for the plate is lettered "*Octopus vulgaris*, var. *americanus*," and since this figure is really the type of the species, it would have been desirable to elevate d'Orbigny's designation into a specific name, and to quote him as the authority for it. The first objection to this is that d'Orbigny seems to have abandoned his idea of establishing this as a formal variety, for in his text he makes no further allusion to its characteristic peculiarities than "Nous avons cru remarquer que les individus américains, tout en présentant les proportions et tous les autres caractères de ceux de nos côtes, sont néanmoins plus tachetés de rouge en dedans de l'ombrelle" (*loc. cit.*, p. 415). The second objection is more serious, and consists in the fact that the name *americanus* has been already applied to an *Octopus* by de Blainville,[1] following de Montfort,[2] who applied the name "Poulpe americain" to a figure published by Barker.[3] The drawing was so insufficient that the name has never come into use, and it would be quite impossible to demonstrate its identity with the present form. Under these circumstances I have not felt justified in adopting d'Orbigny's name, but have thought it better to use Steenstrup's MS. designation.

The individual examined presents some curious irregularities in the disposition of the suckers. The left dorsal arm has the six proximal suckers disposed in the usual manner (the first four being in one series), and after them a gap, large enough to have contained two suckers, which have been, as it were, dislocated on to the umbrella just at the dorsal margin of the arm. The right dorsal arm has a supernumerary sucker just beyond the eleventh; and the third arm on the right side has the nine proximal suckers arranged normally, but beyond them are two transverse rows, each containing three suckers. Such deviations from the usual rule suggest the question whether *Tritaxeopus cornutus*, Owen,[4] may not be merely a case in which a similar malformation is more completely carried out.

Octopus tuberculatus, Blainville.

1826.	*Octopus tuberculatus*,	Blv.,	Dict. d. Sci. Nat., t. xliii. p. 187.
1838.	„	„	d'Orb., Céph. acét., p. 38; Poulpes, pls. xxi., xxiii.
1869.	„	„	Targ., Ceph. Mus. Firenze, p. 18.

Habitat.—Station 122B, off Barra Grande, September 10, 1873; lat. 9° 9′ S., long. 34° 53′ W.; 32 fathoms; red mud. One young specimen.

[1] Dict. d. Sci. Nat., p. 189, 1826.
[2] Buffon de Sonnini, Moll., t. iii. p. 30, pl. xxix., 1802.
[3] *Phil. Trans.*, vol. l. part 2, p. 777, pl. xxix. figs. 1–4, 1758.
[4] *Trans. Zool. Soc. Lond.*, vol. xi. p. 131.

Atlantic, coasts of France, of the Antilles, and of Africa, Mediterranean (d'Orbigny); Gorée, Senegal (W. E. H.), Messina (Targioni-Tozzetti).

A small specimen obtained at the above locality seems to be properly referable to this species, although certainty is impossible in the case of so immature a creature.

I do not propose here to discuss the question how far this species is removed from *Octopus vulgaris*, but it seems to me that they are rather further apart than would be expressed by ranking them as varieties.

Whether *Octopus ruber*, Rafinesque,[1] be identical with this is still more uncertain, the definition of that author being as unsatisfactory as usual. Moreover, his species has been regarded as identical with *Octopus macropus*, Risso, and having regard merely to the colour, which is the character emphasised by Rafinesque's name, this would seem likely; it is to be noted, however, that the arms of *Octopus macropus* very greatly exceed the length mentioned by Rafinesque ("environ le double du corps").

Octopus verrucosus, Hoyle (Pl. IV.).

1885. *Octopus verrucosus*, Hoyle, Diagnoses I., p. 222.
1885. „ „ Hoyle, Prelim. Rep. I., p. 96.

Habitat.—Inaccessible Island, Tristan da Cunha, October 16, 1873. Two specimens, ♂.

The Body is rounded, but so distorted by compression that no further details can be given. The *mantle-opening* extends fully halfway round the body, terminating a little below and behind the eye. The *siphon* is long, evenly conical and pointed, and extends nearly halfway to the umbrella-margin.

The Head is short, not so broad as the body, and with *eyes* but slightly prominent.

The Arms are unequal in length, the second pair being considerably the longest, and almost six times as long as the body; they are comparatively stout, and taper gradually. The *umbrella* extends about one-fifth up the longest arms. The *suckers* are fairly close, deeply cupped and marked with radial grooves (fig. 2), between which are numerous very minute papillæ (fig. 3). About four suckers on each lateral arm, opposite the umbrella-margin, are larger than the others;[2] beyond these they gradually diminish. The extremity of the *hectocotylised arm* resembles that of *Octopus vulgaris*, but is very minute (about 2 mm. long in the larger specimen); it is acutely pointed, and the median groove has three transverse ridges.

The Surface of the back, dorsal surface of the head, and umbrella is covered with irregular closely-set warts, which attain a maximum diameter of several millimetres in

[1] Précis découv. somiol., p. 28.

[2] This is a sexual character, as is clearly shown by the analogy of numerous other species.

the nuchal region, a few larger ones extend down the back on either side of the middle line; the warts extend on to the ventral surface of the body, where they become much smaller, more even, and average less than 1 mm. in diameter; they do not cover the inner surface of the umbrella between the two dorsal arms. Above each eye there seems to have been a short cirrus, but these have been rather damaged.

The Colour is a dull purplish grey, very dark above, much lighter below.

The Jaws are figured on Pl. IV. figs. 4, 5.

Dimensions.[1]

Length, total,	470	mm.
End of body to mantle margin,	55	,,
End of body to eye,	80	,,
Breadth of body,	55	,,
Breadth of head,	40	,,
Eye to edge of umbrella,	60	,,
Length of extremity of hectocotylised arm,	2·5	,,
Breadth of extremity of hectocotylised arm,	1·5	,,
Diameter of largest sucker on lateral arm,	18	,,
Diameter of largest sucker on ventral arm,	8	,,

	Right.		Left.	
Length of first arm,	270[2]	mm.	320	mm.
Length of second arm,	350	,,	380	,,
Length of third arm,	320	,,	320[2]	,,
Length of fourth arm,	260[2]	,,	320	,,

This species differs very markedly from *Octopus granulatus*, Lamk., in the size and form of the tubercles covering the body and head and in the rows of larger ones down the back, as also from *Octopus fontanianus* in which the granulation is much finer. From *Octopus tetricus*, Gould, it differs in the smaller size of the umbrella.

Octopus granulatus, Lamarck.

1799. *Ortopus granulatus*, Lamarck, Mém. Soc. Hist. Nat. Paris, t. i. p. 20.
1838. ,, *rugosus*, d'Orb., Céph. acét., p. 45; Poulpes, pls. vi., xxiii. fig. 2.
1869. ,, *incertus*, Tozz., Cef. Mus. Firenze, p. 22, tav. vi. figs. 9, 11.

Habitat.—St. Vincent, Cape Verde Islands, April 25, 1876; 15 to 20 fathoms. One specimen, .

Simon's Bay, Cape of Good Hope; 10 to 20 fathoms. One young specimen.

Atlantic Ocean, shores of the Antilles and Senegal; Pacific Ocean, Manila, Mauritius, Batavia (d'Orbigny); Ceylon (W. E. H.).

Férussac and d'Orbigny identify this species with *Sepia rugosa*, Bosc,[3] and adopt his name in consequence, but his description is so indefinite that it is hardly sufficient

[1] The arms were so bent and contracted that their lengths can only be regarded as approximate.
[2] Mutilated.
[3] *Actes Soc. Hist. Nat. Paris*, 1792, tab. 5, figs. 1, 2.

to form the criterion of a good species, and hence Lamarck's name is here preferred. A long synonymy is given by those authors, which I have not thought it necessary to repeat.

There seems to be no point of importance by which Targioni-Tozzetti's *Octopus incertus* can be distinguished from the present form.

Like most other rough-skinned species of *Octopus*, this belongs to Professor Steenstrup's group *Schizoctopus*, characterised by having the umbrella between the dorsal arms very short and the cutaneous sculpture continued over its inner surface.

Octopus boscii (Lesueur), var. *pallida* (Pl. I.; Pl. III. fig. 2).

1885. *Octopus Boscii* (Lesueur), var. *pallida*, nov., Hoyle, Diagnoses I., p. 223.
1885. „ „ „ „ Hoyle, Prelim. Rep. I., p. 97.

Habitat.—Station 162, off East Moncœur Island, Bass Strait, April 2, 1874; lat. 39° 10′ 30″ S., long. 146° 37′ E.; 38 fathoms; sand and shells. One specimen, ♂.

Station 163A, off Twofold Bay, Australia, April 4, 1874; lat. 36° 59′ S., long. 150° 20′ E.; 150 fathoms; green mud. Two specimens, 1 ♀, 1 *juv.*

The Body is evenly rounded, with a slight depression in the median ventral line. The *mantle-opening* extends less than halfway round the body, terminating immediately below the eye, and further from it than from the base of the *siphon*, which is long and pointed, has rather a small opening, and extends two-thirds the distance to the umbrella-margin.

The Head is short and not so broad as the body; the *eyes* are only slightly prominent.

The Arms are subequal, nearly four times the length of the body, and taper evenly to fine points. The *umbrella* extends one-third up the arms, being a little wider laterally than dorsally. The *suckers* are closely set, deeply cupped, and marked with regular radial grooves; their biserial arrangement commences immediately after the first. The extremity of the *hectocotylised arm is* large and of the usual form except that its interior is furnished with papillæ instead of transverse grooves and ridges. The *circumoral lip* is low and narrow.

The Surface is covered with warts, which are largest and most numerous on the dorsal surface of the body, head, and umbrella, and dorsal aspect of the arms, where they have a quadrifid or quinquefid form, usually with a small wart in the centre, each forming a figure like a star or rosette (Pl. I. fig. 2). Towards the ventral surface and on the sides of the arms the warts are simple, and much smaller. On the back are about ten long cirri, which are rough with small warts, and above each eye is a very large arborescent cirrus with six or seven smaller ones beside it (Pl. I. fig. 3).

The Colour is a very pale purplish grey, shading off to a creamy white on the ventral surface.

The Jaws are shown on Pl. I. figs. 4, 5.

Dimensions.[1]

Length, total,	325	mm.
End of body to mantle-margin,	65	„
End of body to eye,	70	„
Breadth of body,	70	„
Breadth of head,	50	„
Mouth to edge of umbrella between lateral arms,	65	„
Length of extremity of hectocotylised arm,[2]	8	„
Breadth of extremity of hectocotylised arm,[2]	2·5	„
Diameter of largest sucker,	7	„

	Right.	Left.
Length of first arm,	170 mm.[3]	200 mm.
Length of second arm,	215 „	215 „
Length of third arm,	225 „	220 „
Length of fourth arm,	220 „	220 „

The original *Octopus boscii* was discovered on the western coast of Australia by Péron and Lesueur, and received from the former the manuscript name *Sepia rugosa*, Bosc; Lesueur, however, was of opinion that it was not the same as the species figured by Bosc,[4] and therefore gave it the name of that naturalist, but without publishing any diagnosis.[5]

Férussac and d'Orbigny give a brief description,[6] but do not say upon what it is based, and in the British Museum collection there is a specimen named *Octopus boscii* by Gray,[7] though no trace can be found of what led him to this identification. Under these circumstances it appeared better to accept Gray's opinion and to give a new definition of the old species rather than erect the Challenger specimens into a new one; the more so as Gray's *Octopus* does not disagree in any particular with d'Orbigny's description.

There is, however, a marked difference between it and the Challenger specimens in colour (too great, I think, to be accounted for merely by the disposition of the chromatophores), and the surface ornamentation is better marked in the latter, so I have separated them as a distinct variety.

It seems not impossible that *Octopus tetricus*, Gould, should be referred to this species; the description of the surface ornamentation is very similar, and it comes from

[1] Taken from the largest specimen (♀).
[2] Taken from a smaller specimen, whose total length is 160 mm.
[3] Mutilated.
[4] *Actes Soc. Hist. Nat. Paris*, tab. v. figs. 1, 2.
[5] *Journ. Acad. Nat. Sci. Philad.*, vol. ii. p. 101.
[6] Céph. acét., p. 68.
[7] B. M. C., p. 12.

the same region.[1] One arm bears a supernumerary sucker in the largest specimen (Pl. III. fig. 2).

Octopus tonganus, Hoyle (Pl. VIII. figs. 1, 2).

1885. *Octopus tonganus*, Hoyle, Diagnoses I., p. 225.
1885. „ „ Hoyle, Prelim. Rep. I., p. 100.

Habitat.—The Reefs, Tongatabu. Three mutilated specimens, one ♂, two ♀.

The Body is rounded, depressed, and broader than long, with a marked but shallow median groove on the ventral surface. The *mantle-opening* extends about one-third round the circumference of the body, terminating nearer to the funnel than to the eye. The *siphon* is short and conical, and extends rather more than halfway to the umbrella-margin.

The Head is small and the *eyes* prominent.

The Arms are unequal, the order being 3, 2, 4, 1; on an average they are nearly ten times as long as the body, and taper gradually to very fine points. The *umbrella* is very small, and slightly narrower dorsally than laterally. The *suckers* are for the most part small and closely packed; the first four are arranged in a single row; eight small suckers surround the mouth, but there is no distinct lip. In the male there are four large ones on each lateral arm opposite the margin of the umbrella, beyond which they gradually diminish. The extremity of the *hectocotylised arm* is very minute (fig. 2).

The Surface is in general smooth; the back bears a few small papillæ, but owing to the compression of the specimens it is impossible to make out their exact number. There are three minute cirri over each eye.

The Colour is on the whole grey, paler below; this is due to dark specks sprinkled more or less closely over a cream-coloured ground. One specimen has a purplish patch at either side of the mantle-opening.

Dimensions.[2]

Length, total,	285	mm.
End of body to mantle-margin,	30	„
End of body to eye,	32	„
Length of extremity of hectocotylised arm,	2	„
Breadth of extremity of hectocotylised arm,	0·75	„
Diameter of largest sucker on lateral arm,	5	„
Diameter of largest sucker on dorsal arm,	3	„

	Right.	Left.
Length of first arm,	150 mm.	153 mm.
Length of second arm,	240 „	203 „
Length of third arm,	180 „	235 „
Length of fourth arm,	210 „	213 „

[1] Moll., Wilkes Exped., 474.

[2] Taken from the male specimen.

The three specimens upon which this species is founded were much damaged owing to the pressure to which they had been subjected in packing; it was, however, possible by careful comparison of all three to make out characters distinguishing them from all hitherto known species.

Octopus vitiensis, Hoyle (Pl. VII. figs. 6–8).

1885. *Octopus vitiensis*, Hoyle, Diagnoses I., p. 236.
1885. „ „ . Hoyle, Prelim. Rep. I., p. 100.

Habitat.—The Reefs, Kandavu, Fiji. One small specimen, ♀.

The Body is nearly oblong, but becomes somewhat narrower posteriorly. The *mantle-opening* extends nearly one-third round the body, and terminates some distance below and behind the eye. The *siphon* is long and acutely pointed, and extends about halfway to the umbrella-margin.

The Head is broader than the body, with large laterally prominent *eyes*.

The Arms are subequal, the two lateral pairs being a little longer than the others; on an average they are nearly three times as long as the body, and taper rather rapidly about the middle of their length and then more gradually to fine points. The *umbrella* extends nearly one-third up the arms, least along the dorsal pair. The *suckers* are sunken, comparatively large, with a dark margin and very well-marked radial grooves (Pl. VII. fig. 8). The first two in each arm are in a single series, owing to compression of the arms laterally (fig. 7); there are no enlarged suckers on the lateral arms. The only specimen being a female, no *hectocotylus* is developed.

The Surface of the dorsum of the body bears minute warts scattered here and there; over each eye there is a rather large branched cirrus, with a few small ones scattered round it. The internal surface of the arms is covered with minute hemispherical warts, so as to resemble shagreen (fig. 8).

The Colour is very dark grey, almost black on the dorsal surface and outer surface of the arms; paler grey below and on the inner surfaces of the arms. The dark warty character of the integument is not continued over the inner surface of the membrane uniting the two dorsal arms.

Dimensions.

Length, total,	60 mm.
End of body to mantle-margin,	15 „

	Right.	Left.
Length of first arm,	40 mm.	40 mm.
Length of second arm,	45 „	43 „
Length of third arm,	40 „	43 „
Length of fourth arm,	25[1] „	40 „

[1] Mutilated.

This small and possibly immature form differs from *Octopus tuberculatus*, which it somewhat resembles in the comparative shortness of its arms, in the fewness of its cirri, and more particularly in the shagreen-like internal surface of its arms, which last is its most distinctive peculiarity.

Octopus marmoratus, Hoyle (Pl. VI.).

1885. *Octopus marmoratus*, Hoyle, Diagnoses I., p. 227.
1885. „ „ Hoyle, Prelim. Rep. I., p. 102.

Habitat.—On the Reefs, Honolulu, Sandwich Islands. Three specimens, one ♂, two ♀. Sandwich Islands (Copenhagen Museum).

The Body is round, not depressed, and a little longer than wide. The *mantle-opening* extends somewhat less than halfway round the body, terminating nearer to the siphon than to the eye, and considerably behind the latter. The *siphon* is small and acutely conical, and extends about one-third the distance to the umbrella-margin.

The Head is narrow, and the *eyes* are prominent, where they have not suffered from compression.

The Arms are subequal, eight times as long as the body; they are very long and slender, the last character being more marked in the females than in the male; they taper more rapidly at first than near the extremities, which are much attenuated. The *umbrella* is very wide, especially in the male, where it extends almost one-third up the arms; in the females its extent is only one-sixth. The *suckers* are rather large, and closely set; in the male a few suckers opposite the umbrella-margin are slightly, but not markedly, larger than the others. The extremity of the *hectocotylised arm* is small, and has about ten small transverse ridges (figs. 2, 3).

The Surface appears to have been smooth, except for a few short ridges placed longitudinally on the back and sides; but the skin is shrivelled by the action of the spirit, so that it is difficult to be certain. A conical cirrus is situated above and slightly behind each eye; but in some cases this has been destroyed.

The Colour is a stone-grey, with dark pigment disposed in veins like those of marble[1] on the dorsal surface of the body, head, and umbrella (fig. 1); the male is much darker, so that the marbling is almost concealed. Traces of an oval spot are seen in front of and below the eye on both sides of one female specimen and on one side of the other; but this spot is concealed by the dark colouring in the male even if it exist.

[1] Hence the specific name.

Dimensions.	♀	♂
Length, total,	630 mm.	580 mm.
End of body to mantle-margin,	70 „	80 „
End of body to eye,	95 „	105 „
Breadth of body,	70 „	70 „
Breadth of head,	43 „	50 „
Eye to edge of umbrella (dorsally),	75 „	75 „
Eye to edge of umbrella (laterally),	100 „	105 „
Length of extremity of hectocotylised arm,	...	2 „
Breadth of extremity of hectocotylised arm,	...	1 „
Diameter of largest sucker on lateral arm,	7 „	14 „
Diameter of largest sucker on ventral arm,	...	10 „

	♀		♂	
	Right.	Left.	Right.	Left.
Length of first arm,[1]	530 mm.	490 mm.	460 mm.	315[2] mm.
Length of second arm,	560 „	400 „	400 „	500 „
Length of third arm,	470 „	540 „	315 „	475 „
Length of fourth arm,	560 „	510 „	400 „	470 „

This species presents in some respects a resemblance to *Octopus bimaculatus*,[3] Verrill, namely, in the general form and proportions, in the enlargement of one or more suckers on the lateral arms and in the small size of the hectocotylus of the male, as also in the presence of the dark spot on either side in front of the eye. Each, too, has a supra-ocular cirrus, but the conspicuously warted upper surface of Verrill's form and the equally marked smoothness of the Challenger specimens, as well as the seemingly constant difference of coloration necessitate their separation.

Octopus bimaculatus is from California, so that so far as regards habitat there would be no *à priori* ground for separating the two forms.

The new species agrees with unnamed specimens, from the same locality, in the Copenhagen Museum, in which the spots upon the side of the membrane are even more clearly marked, while the other characters remain the same.

It approaches *Octopus hawaiensis*, E. and S.,[4] in general form, but differs in the presence of cirri over the eyes.

Octopus areolatus, de Haan, MS. (Pl. III. figs. 6, 7).

1835. *Octopus areolatus*, de Haan, MS. letter (*fide* d'Orbigny).
1838. „ „ d'Orbigny, Céph. acét., p. 65.
1838. „ *sinensis* (?), d'Orbigny, Céph. acét., p. 68; Poulpes, pl. ix.
1849. „ *ocellatus*, Gray, B. M. C., p. 15.
1886. „ „ Appellöf, Japanska Ceph., p. 8, pl. i. figs. 1–3.

Habitat.—Station 192, off the Ki Islands, south of Papua, September 26, 1874; lat. 5° 49′ 15″ S., long. 132° 14′ 15″ E.; 140 fathoms; blue mud. One specimen, ♀.

Japan (de Haan, Appellöf); Hong Kong (Copenhagen Museum).

[1] The lengths of the arms are measured from the eye.
[2] Mutilated.
[3] *Bull. Mus. Comp. Zoöl.*, vol. xi. p. 121, 1883.
[4] Voy. "Bonite," p. 9, pl. i. figs 1–5.

The Body is oblong, about as deep as wide. The *mantle-opening* extends nearly two-thirds round the body, terminating immediately behind the eye; the *siphon* is short, conical, and reaches one-fourth the distance up to the umbrella margin.

The Head is small and short, and the *eyes* are not prominent.

The Arms are subequal and about twice as long as the body, tapering evenly to thin points. The *umbrella* is wide, reaching somewhat less than half up the arms; it is continued along each side of them as a narrow fillet, which expands on the ventral aspect into a more or less wide membrane (Pl. III. fig. 6). The *suckers* are small, round, and prominent, the marginal portion being separated by a constriction from the somewhat conical base; they are not closely set. The specimen being a female, the *hectocotylus* is not developed.

The Surface is covered with shagreen-like pimples on the dorsal aspect of the body, head, and umbrella, which are here and there closely set so as to form short longitudinal ridges; above and slightly behind each eye is a low rough wart. The pimpled surface of the umbrella is continued on to its inner surface between the two dorsal arms.

The Colour is a dull purple, paler below; in front of each eye is a peculiar spot consisting of a dark centre separated by a pale ring from a dark external area; on the outer surface of each of the four ventral arms are two rows of dark elongated spots (Pl. III. fig. 7).

Dimensions.

Length, total,	103 mm.
End of body to mantle-margin,	30 „
End of body to eye,	33 „
Breadth of body,	25 „
Breadth of head,	19 „
Eye to edge of umbrella (dorsally),	18 „
Eye to edge of umbrella (laterally),	25 „
Diameter of largest sucker,	2 „
Diameter of the ocellus,	4 „

	Right.	Left.
Length of first arm,[1]	63 mm.	65 mm.
Length of second arm,	70 „	70 „
Length of third arm,	70 „	70 „
Length of fourth arm,	70 „	40[2] „

I have referred this to de Haan's species on the authority of the two specimens in the Copenhagen Museum, which Steenstrup informs me that he identified with some (presumably the types) labelled *Octopus areolatus*, de Haan, in the Leyden Museum.

It agrees with those in the tubercles on the back, the spot in front of each eye (which, however, is smaller in this specimen), and a dark band on the dorsal and second arms; smaller mottlings on the back and sides seen in the others are not so distinct in the

[1] Measured from the eye.

[2] Mutilated.

Challenger specimen owing to the deeper pigmentation of those parts. One of the Copenhagen specimens has two tubercles over each eye, the other none; and in both of them the longitudinal markings seen on the ventral arms are wanting.

Octopus australis, Hoyle (Pl. III. figs. 4, 5).

1885. *Octopus australis*, Hoyle, Diagnoses I., p. 224.
1885. „ „ Hoyle, Prelim. Rep. I., p. 98.

Habitat.—Port Jackson, Australia; 6 to 15 fathoms. Two specimens, one ♀, one immature.

The Body is rounded, and wider behind than in front; depressed, and with a well-marked ventral median groove. A sharp narrow ridge extends along either side of the body to the posterior extremity. The *mantle-opening* extends nearly half round the body. The *siphon* is of medium size; at first the lateral margins are parallel and then taper rapidly to a blunt point; it extends less than halfway to the umbrella margin.

The Head is narrower than the body, and the *eyes* somewhat prominent, dorsally rather than laterally.

The Arms are unequal, the lateral being slightly the largest, and about three times as long as the body; they are slender and tapering. The *umbrella* is longer than the length of the body; larger ventrally than dorsally, and larger laterally than ventrally. The *suckers* are prominent and closely set; they are altogether larger on the lateral arms, and extend in a double row to the centre; the radial grooves are deep, and extend quite to the margins. The specimens being females, no *hectocotylus* is present.

The Surface of the back of the body, head, and dorsal aspects of the umbrella and arms is covered with thick-set hemispherical pimples, which are also found on the inner side of the membrane between the two dorsal arms, and on the inner surfaces of the arms between the suckers. They are smaller and more sparse on the ventral surface of the body. A large rough cirrus and a few pimples larger than the others are found over each eye. A raised ridge passes backwards from the base of the siphon along the ventro-lateral margin of the body, meeting its fellow of the opposite side at the posterior extremity (Pl. III. fig. 5).

The Colour is deep purplish on the back, mottled on the sides, and cream below.

Dimensions.

Length, total,	87 mm.
End of body to mantle-margin,	20 „
End of body to eye,	22 „
Breadth of body,	19 „
Breadth of head,	14 „
Eye to edge of umbrella (dorsally),	16 „
Eye to edge of umbrella (laterally),	23 „
Diameter of largest sucker,	2·5 „

	Right.	Left.
Length of first arm,	55 mm.	60 mm.
Length of second arm,	60 „	63 „
Length of third arm,	65 „	65 „
Length of fourth arm,	40 „	50 „

It is doubtful what value is to be attached to the raised ridge mentioned above; it is to be seen in other species under certain conditions, possibly due either to different modes of preservation or to varying states of contraction; nevertheless, in the majority of forms it is never observed, and I am therefore inclined to attribute to it a certain systematic importance, the more especially as it occurs in both the specimens before me. *Octopus membranaceus*, Q. and G., seems to present the same condition carried out more fully.

The present species is decidedly paler and more ruddy in colour than *Octopus granulatus*, and the granulations are not so large nor so closely set as in that form. The mottling on the sides, too, is very marked.

Octopus tehuelchus, d'Orbigny.

1835. *Octopus tehuelchus*, d'Orb., Amér. mérid., p. 27, pl. i. figs. 6, 7.
1838. „ „ d'Orb., Céph. acét., p. 55; Poulpes, pl. xvii. fig. 6.
1870. „ *megalocyathus*, Phil. (?), Cunningham, Trans. Linn. Soc. Lond., vol. xxvii. p. 474.

Habitat.—St. Thomas, Danish West Indies; 8 fathoms.

East coast of Patagonia; lat. 40° S. (d'Orbigny); Strait of Magellan and Punta Arenas (Cunningham); Nicaragua (Copenhagen Museum).

I refer to this species, not without some hesitation, a small *Octopus* of about 5 cm. in total length, from the West Indies. The body is proportionally a little more elongated than in d'Orbigny's figure, but a specimen in the British Museum, brought by Cunningham from Sandy Point, resembles closely that obtained by the Challenger, which is also much like an unnamed form in the Copenhagen Museum from San Jan de Nicaragua, except that the arms of the latter are somewhat larger.

Cunningham's specimen in the British Museum is almost certainly the one alluded to in the Zoology of the Voyage of the "Nassau" (*loc. cit.*), where he speaks of obtaining it at the eastern end of the Strait of Magellan, and of numbers of mutilated specimens being thrown up on the beach at Punta Arenas. I have not been able to find the original description of "*Octopus megalocyathus*, Phil.," the only species bearing that name known to me being the one described by Gould in the Mollusca of the Wilkes Expedition, p. 471.

Octopus duplex, Hoyle (Pl. VII. fig. 5).

1885. *Octopus duplex*, Hoyle, Diagnoses I., p. 226.
1885. „ „ Hoyle, Prelim. Rep. I., p. 101.

Habitat.—Station 163A, off Twofold Bay,[1] South-East Australia, April 4, 1874; lat. 36° 59′ S., long. 150° 20′ E.; 150 fathoms; green mud. Two specimens, one ♀, one ♂, immature.

The Body is short and evenly rounded, with the merest trace of a median ventral groove. The *mantle-opening* extends about half round the circumference, and terminates halfway between the siphon and the eye. The *siphon* is relatively long, conical, and pointed, and extends about halfway to the umbrella-margin.

The Head is small, and the *eyes* rather prominent

The Arms seem to have been unequal, the lateral the longest, but so many have been mutilated that it is difficult to be certain; they are about four times the length of the body. The *umbrella* extends about one-third up the arms, farthest between the lateral pairs. The *suckers* are large, close, and prominent, with a narrow margin marked off from the basal portion; the radial grooves extend to the margin and form notches in it. The *hectocotylus* is not present, the specimen being a female; the third right arm has been mutilated, but the stump shows no groove running up the outer ventral margin.

The Surface is smooth; an interrupted ridge starting from the base of the siphon passes backwards along the ventro-lateral margin of the body, probably due to contraction. There are three small papillæ above each eye.

The Colour is a pale bluish grey above, shading into a creamy tint below.

Dimensions.

Length, total,	80 mm.
End of body to mantle margin,	15 „
End of body to eye,	17 „
Breadth of body,	18 „
Breadth of head,	13 „
Eye to edge of umbrella,	13 „
Diameter of largest sucker,	2 „

	Right.	Left.
Length of first arm,	55 mm.	53 mm.
Length of second arm,	? „	53 „
Length of third arm,	? „	? „
Length of fourth arm,	43 „	50 „

All my efforts to identify this with any previously known species have failed, which is the more remarkable, inasmuch as it presents no very special distinctive characters.

[1] Hence the specific name.

It will probably prove to be identical with some of the forms from the same region which have hitherto been insufficiently described.

Octopus piscatorum, Verrill.

1879. *Octopus piscatorum*, Vll., Amer. Journ. Sci. and Arts, vol. xviii. p. 470.
1881. „ „ Vll., Ceph. N. E. Amer., p. 377, pl. xxxvi. figs. 1, 2.
1884. „ „ Vll., Second Catal., p. 248.
1885. „ „ Vll., Third Catal., pl. xlii. fig. 5.

Habitat.—Station 8, Færöe Channel, H.M.S. "Knight Errant" Expedition, August 17, 1880; lat. 60° 3′ N., long. 5° 51′ W.; 540 fathoms; ooze. One specimen, ♂.

Station 9, Færöe Channel, H.M.S. "Triton" Expedition, August 23, 1882; lat. 60° 5′ N., long. 6° 21′ W.; 608 fathoms; mud. Two specimens, one ♂, one ♀.

Off La Havre Bank, Nova Scotia, 120 fathoms; near the Grand Bank, 200 fathoms; south of Nantucket Island, 1362 fathoms (Verrill).

It is not a little interesting that this species should have been found on the north-west coast of Europe, whither so many species which have been described from the coast of America seem to extend; another instance will be found in the case of Verrill's *Octopus bairdii*, which has been found by Sars off the Norwegian coast, and by the British expeditions in the Færöe Channel (see next species).

The hectocotylised arm, which Verrill's specimens being females did not show, closely resembles that of *Octopus arcticus*, Prosch, and agrees very well with the figure given by Steenstrup,[1] except that it is rather more pointed at the tip.

Octopus arcticus, Prosch.

1834. *Sepia grönlandica (?)*, Dewh., Nat. Hist. Cetacea, p. 263.
1849. *Octopus arcticus*, Prosch, K. Dansk. Vidensk. Selsk. Skriv., Rk. 5, Bd. i. p. 53, figs. 1–3.
1856. „ „ Stp., Hectocotyl., p. 201, Tav. ii. fig. 2.
1873. „ *Bairdii*, Vll., Amer. Journ. Sci. and Arts, vol. v. p. 5.
1878. „ „ Sars, Moll. Reg. Arct. Norv., p. 339, pl. xxxiii. figs. 1–10.
1881. „ „ Vll., Ceph. N. E. Amer., pp. 368, 421, pl. xxxiii. fig. 1; pl. xxxiv. figs. 5, 6; pl. xxxvi. fig. 10; pl. xxxviii. fig. 8; pl. xlix. fig. 4; pl. li. fig. 1.

Habitat.—Station 57, Færöe Channel, H.M.S. "Porcupine" Expedition, 1869; lat. 60° 14′ N., long. 6° 17′ W.; 632 fathoms. One specimen, ♂.

Station 65, Færöe Channel, H.M.S. "Porcupine" Expedition, 1869; lat. 61° 10′ N., long. 2° 21′ W.; 345 fathoms. Three specimens, one ♂, two immature.

Station 8, Færöe Channel, H.M.S "Knight Errant" Expedition, August 17, 1880; lat. 60° 3′ N., long. 5° 51′ W.; 540 fathoms; ooze. Two specimens, one ♂, one ♀.

[1] Hectocotyl, p. 201, Tav. ii. fig. 2.

Station 9, Færöe Channel, H.M.S. "Triton" Expedition, August 23, 1882; lat. 60° 5′ N., long. 6° 21′ W.; 608 fathoms; mud. One specimen, ♂.

Greenland (Dewhurst); north-east coast of the United States, 85 to 843 fathoms (Verrill); coast of Norway (Sars).

A few words are necessary regarding the synonymy of this species as given above. The number and beauty of the drawings, which Professor Verrill has given of his types, have enabled me to establish beyond any doubt their identity with the specimens obtained from the Færöe Channel; it is equally certain that the form figured by Professor Sars is conspecific with them. That the specimens in my hands are the same as *Octopus arcticus*, Prosch, I was able to establish in 1884 when I had the opportunity of comparing them with the types in the Copenhagen Museum. The identity of this form with *Octopus grœnlandicus* (Dewhurst) cannot be proved, unless it were shown that only one species of *Octopus* occurs on the coast of Greenland, the original description being quite valueless.

Octopus pictus, Brock.

1882. *Octopus pictus*, Brock, Zeitschr. f. wiss. Zool., Bd. xxxii. p. 603, pl. xxxvii. fig. 3 (*non* Verrill).
1883. „ *maculosus*, Hoyle, Proc. Roy. Phys. Soc. Edin., vol. vii. p. 319, pl. vi.
1884. „ „ E. A. Smith, "Alert" Report, p. 36, pl. iv. fig. c.

Habitat.—Port Jackson, Australia (Brock, E. A. Smith); Australia (Hoyle).

To me, personally, a melancholy kind of interest attaches to this species, for it is the first I ventured to describe, being unaware that Dr Brock had, a few months previously, as an appendix to the elaborate anatomical work above quoted, described several new species, among which the present form was one.

Although this species does not occur in the Challenger collection, it appears desirable to mention it here partly as introductory to the following variety, and partly for the sake of rectifying the synonymy.

Brock's original diagnosis may be translated here: "Mantle of the specimen, preserved in alcohol, slightly broader than long. The arms are subequal, not very long compared with the body, and in order of length 3, 2, 4, 1. The second and third pairs are almost exactly equal, and not quite twice as long as the body. Arms tapering constantly towards the tips. Suckers in two regularly alternating series continually decreasing in size. The first three or four smaller than the rest and arranged in a single series. Umbrella equally but slightly developed. Ocular cirri wanting.

"Ventral and inner sides of the arms dull ochre yellow, dorsal and outer sides of the arms darker, somewhat regularly marked with large blackish brown spots, fused at the

edges, and exhibiting a black ring in the centre sharply marked off from the brown ground. Under the lens the dark spots are resolved into aggregations of chromatophores, and it may also be observed that the rings are more deeply placed and shine through the spots, and are therefore probably due to a fixed pigment in the deeper layers of the cutis. The brown spots on the arms bear no rings.

"The distribution of colour in this species is so characteristic that it can hardly be confused with any other hitherto known. The only known specimen (unfortunately defective) is in the Göttingen collection, and was presented by Dr. Schütte of Sydney."

The specimen which came into my hands bore the label "Australia," and I have since seen two in the British Museum from Port Jackson and Kangaroo Island, South Australia, and also four specimens in the Liverpool Free Public Museum, and one in the Museum of the Royal College of Surgeons, London, from unknown localities.

This species furnishes an admirable instance of the uselessness of slight variations in the lengths of the arms as specific characters; a number of specimens which have been examined with respect to this point giving the following results:—

Type specimen, ...	3 and 2 subequal, 4, 1.
Specimen in my own collection, . .	4, 1 and 3 equal, 2.
Four specimens in the Liverpool Museum,[1]	A 3, 4, 2, 1 on one side; 4, 2, 1, 3 on the other. B 3, 4, 2, 1. C 3, 4, 2, 1 (probably; arms much curled). D 2, 3, 1, 4 on one side, doubtful on the other.
"Alert" specimen, ...	2, 3 and 4 subequal, 1.

The example in the British Museum from Kangaroo Island has a curious thin pointed process about 6 mm. long at the aboral end of the body, which led to its receiving a special MS. name, but in all other respects it agrees so closely with *Octopus pictus* that I am inclined to regard it as an individual abnormality.

This specific name appears to have been applied by Blainville to the animal now known as *Parasira catenulata*, at least d'Orbigny quotes *Octopus pictus*, Blainville, with a reference to "Faune française, mollusques" as one of its synonyms, with the addition "d'apres Risso," in whose writings I have been unable to find any allusion to the matter. In this case, seeing that there seems to be some doubt as to Blainville's application of the name, and as it has, at all events, never obtained currency, it seems right to allow Brock's name, which has the priority in reference to the present species, to stand.

Professor Verrill has described a new species of *Octopus*[2] for which he has selected the name "*pictus*," being apparently unaware of its appropriation by Brock; it is quite certain that the two forms are distinct, and therefore as Verrill's name must be changed, I propose that his species should be known as *Octopus verrilli*.

[1] I am indebted to my friend Professor Herdman for measuring these specimens.

[2] "Blake" Suppl., p. 112, pl. iii. fig. 3.

Octopus pictus, Brock, var. *fasciata*, nov. (Pl. VIII. fig. 3).

Habitat.—Port Jackson, Australia, April 23, 1874; 6 to 15 fathoms.

The variety differs from the typical form (1) in the somewhat elongated not spheroidal shape of the body, (2) in the inequality in the shape of the arms, (3) in the prominence of the suckers; none of which are points of great importance, being possibly due to varying states of contraction.

On the other hand, it agrees in the type of colouring, but here the dark pigment is arranged in continuous bands, which are not broken up into rounded patches as is the case in all the specimens I have seen; the spots of the type are, however, arranged in rows disposed similarly to the bands. Furthermore, each band contains an opaque-looking median streak like the centre of the spots, and the number of transverse stripes on the arms corresponds roughly in both forms.

Octopus bermudensis, Hoyle (Pl. II. fig. 5).

1885. *Octopus bermudensis*, Hoyle, Diagnoses I., p. 228.
1885. „ „ Hoyle, Prelim. Rep. I., p. 103.

Habitat.—Bermuda. One young specimen, ♀.

The Body is spheroidal, acuminate behind, and with a median groove ventrally. The *mantle-opening* extends rather less than half round the circumference of the body, and terminates some distance behind and a little below the eye. The *siphon* is long and smooth, and attached by nearly all its length to the head; it extends fully halfway to the umbrella-margin.

The Head is much narrower, and more depressed than the body; the *eyes* are scarcely at all prominent.

The Arms are unequal, in the order 1, 2, 3, 4; about six times as long as the body; they are very long and slender, tapering but slightly. The *umbrella* is small. The *suckers* are small, prominent, and closely set, and the first four stand in a slightly zigzag line. The only specimen being a female, no *hectocotylised arm* was observed.

The Surface is smooth for the most part, but the skin is wrinkled over the posterior acuminate extremity, owing to the action of the spirit; there is one very small wart over each eye.

The Colour is yellow ochre, with a pale sienna patch on the back and one on the head.

Dimensions.

Length, total,	58 mm.
End of body to mantle margin,	10 „

	Right.	Left.
Length of first arm,	50 mm.	48 mm.
Length of second arm,	43 „	40 „
Length of third arm,	38 „	38 „
Length of fourth arm,	30 „	32 „

This specimen is probably immature, but its characters are so well marked that I have little hesitation in making it the type of a new species; it differs from *Octopus pusillus*, Gould, in the very small size of the umbrella, and from *Octopus aranea*, d'Orb., which it resembles in the length of its arms, in the fact that here it is the dorsal, there the ventral arms, which markedly exceed the others. The arms are much longer than in *Octopus eudora*, Gray.

Octopus macropus, Risso.

1814. *Octopus ruber* (*?*), Raf., Précis découv. somiol., p. 28.
1826. „ *macropus*, Risso, Hist. Nat. Eur. Mérid., t. iv. p. 3.
1826. „ *Cuvierii*, d'Orb., Céph. acét.; Poulpes, pl. iv. (*nomen tantum*).
1838. „ *Cuvieri*, d'Orb., Céph. acét., p. 18; Poulpes, pls. i., iv., xxvii.
1851. „ *macropus*, Vér., Céph. médit., p. 27, pl. x.
1869. „ „ Targ., Cef. Mus. Firenze., p. 23.
1869. „ *Cuvieri*, Targ., Cef. Mus. Firenze., p. 24.
1886. „ „ Appellöf, Japanska Ceph., p. 6, pl. i. fig. 6.

Habitat.—Yokohama, Japan, purchased in the market. One specimen, ♀.

Canaries, Indian Ocean, Red Sea (d'Orbigny); Japan (Appellöf); Mediterranean (Risso, d'Orbigny, Vérany, &c.); Adriatic (Ninni).

This specimen agrees with d'Orbigny's description in every particular except that the "cirrhe postérieur médiane" could not be found, but as the skin in that region was much wrinkled and contracted, that is not a matter of much moment, especially as, according to Vérany, its presence is not constant.

The synonymy of this species requires a little notice; and in regard to it two questions arise:—Are *Octopus macropus* and *Octopus cuvieri* to be regarded as one species?—and if so, what name is that species to bear?

Two of the greatest authorities who have written on the subject, Vérany and d'Orbigny, unite them, but under different names, while the only modern writer who separates them is Targioni-Tozzetti (*loc. cit.*). Not having sufficient material to form an opinion on the subject, I wrote asking the opinion of my friend Dr. Jatta, of the Naples Zoological Station, who has an extensive knowledge of the Cephalopoda of the

Mediterranean. He is of opinion that they are identical, and that view I have adopted in the present Report.

As regards the name, seeing that Risso's was accompanied by a description in a published book, while d'Orbigny's was merely inscribed at the bottom of a plate which appears to have been in the first instance privately distributed, it appears right to adopt that of the former author.

What the *Octopus ruber* of Rafinesque really was will probably always remain doubtful. Cantraine[1] adopted the name for this species because its colour is generally ruddy, but the account of the length of the arms ("antenopes égaux, environ le double du corps") is strongly at variance with this hypothesis.

Octopus bandensis, Hoyle (Pl. VII. figs. 9, 10).

1885. *Octopus bandensis*, Hoyle, Diagnoses I., p. 227.
1885. „ „ Hoyle, Prelim. Rep. I., p. 102.

Habitat.—Banda. One young specimen.

The Body is rounded and depressed (? from pressure), and with a slight ventral groove. The *mantle-opening* terminates immediately below and behind the eye. The *siphon* extends as far as the umbrella-margin, and is acutely pointed.

The Head is broader than the body, and flattened by compression; the *eyes* are very prominent.

The Arms are unequal, the third pair being much the longest and stoutest; on the average they are four times as long as the body; they taper gradually at first, and then more rapidly. The *umbrella* is very small. The *suckers* are prominent, the first four being disposed in a single series (incorrectly shown on Pl. VII. fig. 10); and none are enlarged on the lateral arms. No *hectocotylised arm* was present in the single specimen.

The Surface is smooth in general, but there are about twelve warts on the back and sides of the body, and a large cirrus over each eye, with several smaller ones near it.

The Colour is deep black, apparently owing to treatment with osmic acid.

Dimensions.

Total length, ...	25 mm.
End of body to eye, ...	6 „

This minute specimen presents so striking an elongation of its third pair of arms as compared with the others that it is impossible to refer it to any hitherto known species.

[1] Malacol. médit., p. 18.

Octopus januarii, Steenstrup, MS. (Pl. VII. figs. 1 4).

... *Octopus januarii*, Steenstrup, MS. in Mus. Havn.
1885. „ „ Hoyle, Diagnoses I., p. 229.
1885. „ „ Hoyle, Prelim. Rep., p. 105.

Habitat.—Station 122, off Barra Grande, Brazil, September 10, 1873; lat. 9° 5′ S., long. 34° 50′ W.; 350 fathoms; red mud. One specimen, ♂.

Station 237, North Pacific, east of Japan, June 17, 1875; lat. 34° 37′ N., long. 140° 32′ E.; 1875 fathoms; blue mud. One specimen, ♂.

Rio Janeiro (Copenhagen Museum).

The Body is rounded, widening a little posteriorly; the ventral groove is very faint. The *mantle-opening* terminates just below the eyes. The *siphon* is bluntly conical, and extensively attached to the umbrella; it extends less than halfway to the umbrella margin.

The Head is small, and the sides are entirely occupied by the enormous *eyes*, which are swollen and globular, but with very small palpebral openings. The skin covering them is so thin that the dark pigment within is distinctly visible.

The Arms are unequal, the dorsal pair being the largest; on an average they are six times as long as the body. The *umbrella* is about equally wide all round, except that it is a little shorter between the two ventral arms.

The Suckers are comparatively small, prominent, and separate; more widely in one specimen than in the other, probably owing to its being less contracted by spirit. None of the suckers on the lateral arms are enlarged, notwithstanding the sex. The extremity of the *hectocotylised arm* is well developed; it is broad, and tapers rapidly to an acute point; in one specimen about seven transverse ridges can be counted in the proximal half of the median groove; in the distal half and in the other specimen they are indistinct (Pl. VII. fig. 2).

The Surface is perfectly smooth all over.

The Colour is a pale purplish-pink; deeper above than below.

The Jaws are shown in Pl. VII. figs. 3, 4.

Dimensions.[1]

Length, total,	285 mm.
End of body to mantle margin,	35 „
End of body to eye,	47 „
Breadth of body,	42 „
Breadth of head,	32 „
Eye to edge of umbrella,	58 „
Length of tip of hectocotylised arm,	10 „
Breadth of tip of hectocotylised arm,	4 „
Diameter of largest sucker,	3·5 „

[1] The measurements are from the Barra Grande specimen; it was in better condition than the other, which had also a length of about 290 mm. The lengths of the arms are measured from the eye.

	Right.	Left.
Length of first arm,	250 mm.	225[1] mm.
Length of second arm,	230 „	220 „
Length of third arm,	145 „	160 „
Length of fourth arm,	165 „	160 „

The two specimens in the Challenger collection agree in all essential particulars with several in the Copenhagen Museum, so that I have gladly adopted Professor Steenstrup's MS. name for the species, recalling the fact that it was first obtained off Rio Janeiro.

On a recent visit to Paris, Dr. Paul Fischer showed me some specimens of an *Octopus* obtained in large numbers by the "Talisman"; from the hurried glance, which was all I could give them, they seemed to present a considerable resemblance to this form, but without further examination it would be impossible to form any opinion as to their identity.

It is not a little remarkable that the same species of *Octopus* should be found in such diverse localities as is here the case; it is further noticeable that the smaller specimen furnishes one of the very few instances in which an *Octopus* was brought up by the deep-sea dredge or trawl, the genus being usually found only in comparatively shallow water. If Dr. Fischer's specimens should prove to belong to the same species the opinion would be forcibly suggested that we have here to do with a veritably abyssal *Octopus*.

Octopus levis, Hoyle (Pl. II. figs. 1–4; Pl. III. fig. 1).

1885. *Octopus levis*, Hoyle, Diagnoses I., p. 229.
1885. „ „ Hoyle, Prelim. Rep. I., p. 104.

Habitat.—Station 151, off Heard Island, Southern Ocean, February 7, 1874; lat. 52° 59′ 30″ S., long. 73° 33′ 30″ W.; 75 fathoms; volcanic mud. Four specimens, one ♂, one ♂ immature, two ♀ immature.

The Body is oblong, depressed, and bulges a little at the sides. The *mantle-opening* extends about one-third round the circumference, terminating about midway between the siphon and the eye. The *siphon* is short and small, extending scarcely one-third the distance to the umbrella-margin.

The Head is almost as broad as the body; and the *eyes* are large, spheroidal, and prominent, with very small circular apertures.

The Arms are subequal and short, compared with the body, being about three times its length; they taper gradually to moderately fine points. The *umbrella* is large, extending about one-third of the arms. The *suckers* are small and prominent, and arranged in two rows from the commencement (Pl. III. fig. 1); a narrow well-marked

[1] The extreme tip is wanting.

groove runs across the arm between each two suckers (possibly due to contraction). The extremity of the *hectocotylised arm* is well-developed, short, and tapering rapidly to a blunt point; the median groove has about ten transverse bars (Pl. I. fig. 2). The *circumoral lip* is unusually thick (Pl. III. fig. 1).

The Surface appears to have been perfectly smooth,[1] but is now covered with wrinkles, due to the action of the spirit.

The Colour is a dull grey, inclining to stone-colour below.

The Jaws are shown in Pl. II. figs. 3, 4.

Dimensions.

Length, total,	190 mm.
End of body to mantle margin,	43 „
End of body to eye,	50 „
Breadth of body,	40 „
Breadth of head,	35 „
Eye to edge of umbrella,	50 „
Length of extremity of hectocotylised arm,	7 „
Breadth of extremity of hectocotylised arm,	4 „
Diameter of largest sucker,	3 „

	Right.	Left.
Length of first arm,[2]	125 mm.	140 mm.
Length of second arm,	130 „	140 „
Length of third arm,	100 „	130 „
Length of fourth arm,	135 „	130 „

The establishment of this species is more than usually satisfactory, being based upon no less than four specimens; and although three of these were of small size, yet they agree so well with the large one that there would be no doubt as to their identity even had they not been obtained at the same Station.

In some respects, for instance, in the absence of cirri, and in its smooth skin, it resembles *Octopus tehuelchus*, d'Orbigny, but the specimens differ from the latter so very markedly in colour (d'Orbigny's form being of a deep blackish-brown), and in some minor points, that there is no doubt they are distinct.

In its smoothness and in the form and dimensions of the extremity of its hectocotylised arm it also resembles *Octopus januarii*, Steenstrup, but it is certainly distinct. From *Octopus favonia*, Gray, it differs in the presence of a stout circumoral lip, and in the double row of cups reaching quite up to it (Pl. III. fig. 1); the latter is in most cases a comparatively insignificant character, but seems to be of more value in the present instance because the arms were strongly bent back from the mouth, a condition in which the suckers would naturally tend to form a single series.

[1] Hence the specific name.

[2] The lengths of the arms are measured from the margin of the mouth.

Octopus punctatus, Gabb (Pl. V.).

1862. *Octopus punctatus*, Gabb, Proc. Calif. Acad., vol. ii. p. 170.
1866. „ „ Dall, *Ibid.*, vol. iii. p. 243, fig. 27.
1883. „ „ Vll., "Blake," Suppl., p. 117, pls. iv., v., fig. 2.
1885. „ *Hongkongensis*, Hoyle, Diagnoses I., p. 224.
1885. „ „ Hoyle, Prelim. Rep. I., p. 99.

Habitat.—Station 232, the *Hyalonema*-ground, off Ino Sima Island, Japan, May 12, 1875; lat. 35° 11′ N., long. 139° 28′ E.; 345 fathoms; green mud. One specimen, ♂.

Pacific Coast, San Francisco to Sitka, Alaska (Verrill); Hong Kong (Copenhagen Museum).

This species was identified in the summer of 1884 by comparison with four specimens which had been named by Steenstrup, *Octopus hongkongensis*, and although the Challenger example greatly exceeded them in size, it nevertheless agreed with them so remarkably in the form of the minute pimples on the body and in the shape and proportions of the hectocotylised arm, that there could be no doubt they all belonged to the same species. Since that time Professor Verrill has kindly sent me a copy of his descriptions of two species of *Octopus* from California (*op. cit.*), and a comparison of his account of *Octopus punctatus*, with the Challenger specimen from Japan, has convinced me that they must all be referred to one type, which will of course bear the name selected by Gabb.

A large sucker, some 30 mm. or more in diameter, in the British Museum, seems to me almost certainly to have belonged to an individual of this species.

I append the dimensions of the Challenger specimen for comparison with those given by Verrill; the length of the arms seems to be very variable.

Dimensions.

Length, total,	650 mm.
End of body to mantle-margin,	70 „
End of body to eye,	90 „
Breadth of body,	90 „
Breadth of head,	65 „
Eye to edge of umbrella (dorsally),	130 „
Eye to edge of umbrella (laterally),	150 „
Length of extremity of hectocotylised arm,	31 „
Breadth of extremity of hectocotylised arm,	4 „
Diameter of largest sucker,	11 „

	Right.	Left.
Length of first arm,	510 mm.	530 mm.
Length of second arm,	520 „	500 „
Length of third arm,	290 „	440 „
Length of fourth arm,	355 „[1]	410 „

[1] The extremity is missing.

Octopus brevipes, d'Orbigny.

1838. *Octopus brevipes*, d'Orb., Céph. acét., p. 61; Poulpes, pl. xvii. fig. 1.

Habitat.—North Pacific, April 3, 1875; lat. 24° 49′ N., long. 138° 34′ E.; surface. One specimen.

North Atlantic; lat. 23° N., long. 32° W. (d'Orbigny).

A small specimen (11 mm. long) in the collection resembles d'Orbigny's figure so closely that I apply his name to it. The colour, however, is much darker along the dorsal surface of the arms; it is almost certain that both are young forms, perhaps of two distinct species.

Octopus sp.

Habitat.—Station 188, south of Papua, September 10, 1874; lat. 9° 59′ S., long. 139° 42′ E.; 28 fathoms; green mud. One specimen.

An immature specimen, which could not be determined, was obtained at this Station.

Octopus sp.

Habitat.—Station 184, east of Cape York, August 29, 1874; lat. 12° 8′ S., long. 145° 10′ E.; 1400 fathoms; Globigerina ooze. One specimen.

At this Station the trawl brought up some fragments of an *Octopus*, which it was quite impossible to determine.

Eledone, Leach.

The species of this genus are exceedingly difficult to discriminate, and it is by no means certain into how many even the commonly occurring European forms should be divided.

The difficulties are of the same kind as those encountered in the genus *Octopus*, and the remarks made under that heading (see p. 74) apply equally here also.

It seems necessary to go to some extent into the history of this generic name, since Dr. de Rochebrune has recently discussed it [1] and arrived at a conclusion whither I can hardly follow him.

For the present purpose it is not necessary to refer to any pre-Linnean authors, for, as Dr. de Rochebrune himself admits, they are not to be considered in cases of priority; we have therefore merely to inquire who was the first after the year 1758 (or 1766) to formally establish the present genus. In the year 1817, Leach wrote, in the Zoological Miscellany (vol. iii. p. 137), thus, "Pedes antliis simplice serie instructi, consimiles,

[1] Monogr. Eledonidæ.

1. ELEDONE,"[1] in 1826, d'Orbigny enumerated the genus by the same name in his "Tableau méthodique";[2] and in the same year Risso also adopted the genus but altered the spelling to "*Eledona*," either with the view of approximating it to customary Latin spelling, or merely following the example of Belon, Aldrovandus, and others.

The conclusion which de Rochebrune draws from these facts is that Risso is the author of the genus. This seems to me quite untenable, and calculated to lead to the utmost confusion, in addition to which it is obviously unjust to give to a writer who merely makes a literal alteration in the spelling of a word the credit of founding the genus. A few examples will make my meaning clear. In 1835 d'Orbigny separated Blainville's "Calmars flèches" as a distinct genus *Ommastrephes*, since which some other authors, of whom I believe Lovén[3] was the first, have preferred to spell it *Ommatostrephes;* but are we therefore to speak of it as "*Ommatostrephes*, Lovén, 1847"? Again the year before last, Dr. de Rochebrune himself thought fit to erect *Loligopsis ellipsoptera*, Adams and Reeve, into a genus "*Dyctydiopsis*." This is in distinct violation of the ordinary rule for transliterating Greek words, whereby ι should become *i* not *y*, but if, in adopting his genus, I were to make this correction, I do not think any future writer, even though he might approve of this spelling, would be justified in calling the genus "*Dictydiopsis*, Hoyle, 1886."

The question whether Risso's proposed alteration was desirable or not does not affect the question; it may well be left as a matter of opinion. To me, I confess, it seems that *Eledone* is the preferable form, and as it has priority I prefer to use it; indeed I should be loth to interfere with any published spelling except on the ground of flagrant inaccuracy.

Eledone cirrosa (Lamarck), d'Orbigny.

1776. *Sepia octopodia* (*?*), Pennant, Brit. Zool., vol. iv. p. 53, pl. xxviii. fig. 44.
1799. *Ortopus cirrhosus*, Lmk., Mém. Soc. Hist. Nat. Paris, t. i. p. 21, pl. i. fig. 2.
1814. *Ozoena aldrovandi* (*?*), Raf., Précis découv. somiol., p. 29.
1827. *Ortopus ventricosus*, Grant, Edin. N. Phil. Journ., p. 309.
1829. „ *aldrovandi*, d. Ch., Mem. stor. nat., pp. 45, 57, tav. lvi.
1838. *Eledone cirrhosus*, d'Orb., Céph. acét., p. 79; Elédons, pl. ii.
1843. „ *pennantii*, Macgillivray, Moll. Anim. Scot., p. 31.
1843. „ *aldrovandi* (*?*), Macgillivray, *Ibid.*, p. 32.
1851. „ *aldrovandi*, Vér., Céph. médit., p. 12, pls. ii., iii.
1851. „ *genei*, Vér., *Ibid.*, p. 15, pl. i.
1853. „ *cirrhosus*, Forbes and Hanley, Brit. Moll., vol. iv. p. 211, pl. KKK fig. 4; pl. MMM fig. 1.
1869. „ *cirrosa*, Jeffreys, Brit. Conch., vol. v. p. 146, pl. vii. fig. 2.

Habitat.—Off the Butt of Lewis, H.M.S. "Triton" Expedition, August 25, 1882; 40 fathoms. One specimen, ♀.

[1] De Rochebrune is in error when he states (*op. cit.*, p. 153) that Leach used the form "Eledon."
[2] *Ann. d. Sci. Nat.*, t. vii. p. 145. [3] *Öfversigt k. Svensk.-Vetensk. Akad. Förhandl.*, Årgången, p. 135, 1846.

Off Wexford, H.M.S. "Porcupine" Expedition, 1869. One specimen, ♀.

Britain (Pennant, Forbes and Hanley, Jeffreys); Norway (Lovén, Steenstrup); Mediterranean (as *Eledone aldrovandi*, Vérany).

Of this species I have examined a considerable number from our own coast as well as some from other localities, and feel pretty confident that the table of synonyms above given, though long, is correct. I have compared some specimens of *Eledone aldrovandi* received from the Zoological Station at Naples, with young specimens from our own coast, and can detect absolutely no points of specific importance between them.[1] Older specimens, as compared with the young ones, are proportionately longer in the body, the tubercles on the back are more prominent, and the arms better developed. One or two specimens from the east coast of Scotland are quite smooth, but I am disposed to attribute this to their having been kept some time after death before being placed in spirit, an opinion confirmed by their soft flabby consistency.

The contraction due to this reagent often causes a disposition of the suckers in two series on longer or shorter portions of the arms, and in some cases this is so consistent and regular that it would not be difficult on cursory examination to mistake the specimen for an *Octopus*.

Not having seen a male, I have been unable to confirm Steenstrup's observation regarding the structure of the extremities of the arms in that sex.[2] He found in a specimen from Bergen that the suckers ceased a little below the tip, and were replaced by pairs of minute cirri; it would be very desirable to repeat this observation because Steenstrup remarks that his specimen was in poor condition, and because the specimens of *Eledone aldrovandi* from Naples disagree in this respect with his description, but resemble *Eledone moschata* in possessing not cirri but cuticular folds at their ends; this structure is figured by Steenstrup,[3] and is visible on specimens sent me from Naples. If the male *Eledone cirrosa* really possesses these paired threads it would tend to prove that *Eledone aldrovandi* was not identical with it, but, as above remarked, I have been unable to separate them by any external characters.

What Macgillivray's *Eledone aldrovandi* was it seems impossible to determine with any certainty; it may have been a distorted specimen of the present species, but in any case the name must be dropped.

Eledone octopodia (Pennant) has been adopted by some authors as a name for this species, but even if it could be proved beyond question that Pennant's *Sepia octopodia* is identical with it, then his name would not take precedence of the others, because he did not name the species at all, but merely referred it erroneously to Linné's type, which we now know as *Octopus vulgaris*.

[1] I have just ascertained that the identity of *Eledone cirrosa* (*Eledone pennanti*) with *Eledone aldrovandi* has been already suggested by Dr. Paul Fischer (*Journ. de Conch.*, sér. 3, t. vii. p. 13, 1867).

[2] Hectocotyl, p. 206, Tav. ii. fig. 6.

[3] *Op. cit.*, Tav. ii. fig. 5.

Eledone verrucosa, Verrill.

1881. *Eledone verrucosa*, Vll., "Blake" Report, p. 105, pls. v., vi.
1881. „ „ Vll., Ceph. N. E. Amer., p. 330, pls. lii., liii.
1884. „ „ Vll., Second Catal., p. 248.

Habitat.—Station 170A, off the Kermadec Islands, north of New Zealand; July 14, 1874; lat. 29° 45′ S., long. 178° 11′ W.; 630 fathoms; volcanic mud. One specimen, ♂.

North Atlantic, south east of Long Island; off Nantucket; off Martha's Vineyard; off Delaware Bay; 466–1255 fathoms (Verrill).

The agreement between the Challenger specimen and the admirable drawings and description of Professor Verrill is so close that there can be no doubt as to the correctness of this identification. The only differences appear to be that in the American specimens the cirri round and above the eyes are a little more prominent than in that from the Pacific, while the latter has the extremity of the hectocotylised arm formed like that of an *Octopus* rather than like that of an *Eledone*, as shown in Verrill's figure. The Challenger specimen, moreover, has the second pair of arms the longest, the first come next, while the third and fourth are subequal and still a little shorter; but as appears from Verrill's measurements (*loc. cit.*), these proportions are liable to variation.

The point of greatest interest in connection with this specimen is its capture so far away from the original habitat of the species, but this, as will appear in the sequel, is not without parallel (see p. 223).

Eledone rotunda, Hoyle (Pl. VIII. figs. 4–6).

1885. *Eledone rotunda*, Hoyle, Diagnoses I., p. 230.
1885. „ „ Hoyle, Prelim. Rep. I., p. 105.

Habitat.—Station 157, in the Southern Ocean, March 3, 1874; lat. 53° 55′ S., long. 108° 35′ E.; 1950 fathoms; Diatom ooze. One specimen, ♀.

Station 298, off Valparaiso, November 17, 1875; lat. 34° 7′ S., long. 73° 56′ W.; 2225 fathoms; blue mud. One specimen (arms only), ♀.

The Body is spheroidal, very little longer than broad, and the ventral groove is not marked. The *mantle-opening* extends one-third round the body, ending some distance directly below the eyes. The *siphon* is slightly tapering, and extends one-third the distance to the umbrella margin.

The Head is short, nearly as broad as the body, and the *eyes* are round and rather prominent.

The Arms are equal, and about twice as long as the body; they are very stout,

and taper gradually to blunt points; their section shows a triangle projecting inwards, and a rounded surface looking outwards; the former much more prominent than the latter. The *umbrella* is wide, extending one-third up the arms, a little further dorsally than ventrally. The *suckers* are comparatively small, closely set, and deeply cupped. No *hectocotylus* was found on either specimen, hence they are considered to be females, a supposition subsequently verified in the case of the one whose body was preserved.

The Surface is perfectly smooth.

The Colour is dull purple, palest on the body, and deepest on the inner surface of the umbrella.

The Jaws are shown on Pl. VIII. figs. 5, 6.

Dimensions.

Length, total,	165 mm.
End of body to mantle-margin,	45 „
End of body to eye,	55 „
Breadth of body,	45 „
Breadth of head,	35 „
Eye to edge of umbrella,	50 „
Diameter of largest sucker,	3 „

	Right.	Left.
Length of first arm,[1]	100 mm.	105 mm.
Length of second arm,	105 „	100 „
Length of third arm,	110 „	100 „
Length of fourth arm,	110 „	105 „

The better preserved of these two specimens is of interest as having come from the Southern Ocean, of the fauna of which we have but scanty reports; the mangled remains of another from the South Pacific, which have been referred with some doubt to the same species, indicate that it may perhaps have a wide range in deep water, for both examples appear to be from a depth of about 2000 fathoms.

Eledone brevis, Hoyle (Pl. VIII. fig. 7).

1885. *Eledone brevis*, Hoyle, Diagnoses I., p. 230.
1885. „ „ Hoyle, Prelim. Rep. I., p. 106.

Habitat.—Station 320, off Monte Video, February 14, 1876; lat. 37° 17′ S., long. 53° 52′ W.; 600 fathoms; green sand. Three specimens, ♀.

The Body is short, rounded, and depressed; blunt behind, and deeply grooved below. The *mantle-opening* extends one-third round the animal, and terminates immediately below the eyes. The *siphon* is short, acutely pointed, and extends less than halfway to the umbrella margin.

[1] The lengths of the arms are measured from the eye.

The Head is short, and nearly as broad as the body. The *eyes* are spheroidal, and very prominent.

The Arms are equal, and about half as long again as the body; they are short, stout, and taper gradually to blunt points. The *umbrella* extends halfway up the arms,—rather more in the largest specimen. The *suckers* are round, prominent, and deeply cupped, and there are about thirty on each arm. The *hectocotylus* is not present on any of the specimens, all being females.

The Surface is smooth, with the exception of three cirri arranged in a triangle over each eye. (By a mistake of the lithographer the cirri are represented as *below* the eye.) Behind the left eye in the largest specimen the skin is elevated into a number of small papillæ, and a few similar ones are seen on the back of the medium-sized specimen.

The Colour is a dull purplish-grey above, inclining to pale ochre below.

Dimensions.

Length, total,	55 mm.
End of body to mantle-margin,	15 „
End of body to eye,	20 „
Breadth of body,	22 „
Breadth of head,	20 „
Eye to edge of umbrella,	23 „
Diameter of largest sucker,	1 „

	Right.	Left.
Length of first arm,	35 mm.	35 mm.
Length of second arm,	35 „	35 „
Length of third arm,	31 „	31 „
Length of fourth arm,	30 „	30 „

The three little specimens of *Eledone*, trawled off the mouth of the Rio de la Plata, are not like any others of the genus known to me. The short arms, the smooth or slightly roughened dorsal surface, and three well-marked constant cirri over each eye, are very characteristic.

Eledonella, Verrill.

Japetella, Hoyle (*pars*).

This genus was created by Verrill in 1884[1] for a small *Eledone*-like Cephalopod dredged by the U.S. Fish Commission Steamer "Albatross" off the American coast in 2949 fathoms. In March of last year, not having then received Professor Verrill's paper, I described a very similar form from the Pacific Ocean under the name *Japetella*, a genus erected for it and for another form from the South Atlantic, for which I have still retained it, the two forms being clearly distinguished by the presence

[1] Second Catal., p. 14.

or absence of a median septum in the branchial cavity. Verrill does not appear to have opened the siphon of his specimen, for he does not allude to a pad in its dorsal wall; in the Challenger specimen this pad was free at its anterior extremity, forming a valve, but I am not sure that the separation was not artificial.

Eledonella diaphana, Hoyle (Pl. IX. figs. 3–6).

1885. *Japetella diaphana*, Hoyle, Diagnoses I., p. 232.
1885. „ „ Hoyle, Prelim. Rep. I., p. 108.

Habitat.—Station 220, north of Papua, March 11, 1875; lat. 0° 42′ S., long. 147° E.; 1100 fathoms (?); Globigerina ooze. One specimen, sex ?.

The Body is gelatinous and semitransparent; it is ovoid in form, and considerably longer than broad. The *mantle-opening* is very wide, extending up behind the eyes on either side. The *siphon* extends two-thirds of the distance to the umbrella margin, and is truncated at the extremity; it has a thick pad on its dorsal wall, which seems to form a valve by its free tip. There is a *median septum* in the branchial cavity (Pl. IX. fig. 4).

The Head is nearly as broad as the body, and the *eyes* are large and prominent; they consist of a larger, darkly pigmented spheroid, from which protrudes the opaque white, smaller, spheroidal lens.

The Arms are unequal; the longest (the third pair) are almost as long as the body, and are nearly twice as long as the fourth, which are the shortest, the order of length being 3, 2, 1, 4; they taper rapidly to fine points. The *umbrella* is very small, extending about one-fourth up the dorsal and ventral arms, a little further up the dorso-lateral and lateral arms, and being least developed in the space between the ventral and ventro-lateral arms (fig. 5). The *suckers* have assumed, probably owing to shrinking, a quadrangular or triangular form (fig. 6); they are prominent, and marked by two constrictions, one at the base, separating them from the arm, the other rather more than halfway up. There is no trace of any *hectocotylus*.

The Surface appears to have been smooth originally, but the epithelium has been to a great extent stripped off.

The Colour is very pale yellowish-grey, marked with numerous longitudinally disposed oblong chromatophores.

Dimensions.

Length, total,	36 mm.
End of body to mantle-margin,	16 „
End of body to eye,	18 „
Eye to edge of umbrella,	9 „
Length of third pair of arms,	18 „

In the Preliminary Report this specimen was recorded as being from the "surface," firstly, on the ground that it was so noted in the manuscript Station Book, kept during

the cruise, and, secondly, because of the pale semitransparent appearance which suggested its specific name. It seems better, however, to omit this and to leave the depth from which the specimen was taken an open question; there was, so far as I can ascertain, no objective evidence that the animal had been taken at the surface, and in the only two cases in which examples of this genus have been obtained the dredge or trawl had been to a great depth. Professor Steenstrup's five specimens of his *Bolitæna microcotyla*, a form nearly allied to this, were all taken in the surface net with Medusæ and other pelagic organisms at very distant localities.

The question as to the specific identity, or otherwise, of this form with that described by Verrill seems at present to admit of no decision; the extent of variation in a genus consisting at present of only two specimens is, of course, quite uncertain, the more so as these belong apparently to different sexes. It seems, therefore, that the interests of science will be best served by recording the two as distinct, though I have a strong suspicion that they will eventually be proved to be identical, and had the knowledge of Verrill's species come to me in time I should not have proposed a new name.

The present type resembles *Bolitæna*, Steenstrup, in the gelatinous consistency of the body, in the presence of a median septum in the branchial cavity, in the wide opening of the mantle, which extends to just behind the eyes, and in the preponderance of the third pair of arms. They differ, however, in a considerable number of important characters. In *Bolitæna microcotyla* the distance from the eye to the extremity of the arms is somewhat greater than from the eye to the end of the body, whereas in *Eledonella* it is only about half as great; and whilst in *Bolitæna* there are fourteen small widely separated suckers on the longest arm, in *Eledonella* there are sixteen larger ones closely placed. In *Bolitæna* the colour is a brownish-purple, with irregular dark brown mottlings, and a delicate web extends about halfway up the arms, while in *Eledonella* the colour is almost white, with elongated oval brownish spots, and the web extends only one-fourth up the dorsal arms, and to a somewhat less extent between the others.

The genus *Eledonella* furnishes one of the instances in which closely similar, if not identical, forms occur both in the Western Atlantic and the Western Pacific (compare pp. 184, 223).

Japetella,[1] Hoyle.

Body gelatinous in consistency and semitransparent, and more or less oblong in form. *Mantle-opening* very wide. *Siphon* provided with a *valve*. No *median septum* in the branchial cavity.

Arms unequal, and the longest only about equal in length to the body. *Umbrella* small, and the *suckers* arranged in a single series.

[1] Named in honour of Professor Japetus Steenstrup, whose brilliant researches have added so much to our knowledge of this group, and who examined this specimen and the one just described with peculiar interest.

Japetella prismatica,[1] Hoyle (Pl. IX. figs. 1, 2).

1885. *Japetella prismatica*, Hoyle, Diagnoses I., p. 231.
1885. „ „ Hoyle, Narr. Chall. Exp., vol. i. p. 271, fig. 107.
1885. „ „ Hoyle, Prelim. Rep. I., p. 107, woodcut.

Habitat.—Station 126, off the Rio San Francisco, Brazil, September 12, 1873; lat. 10° 46′ S., long. 36° 8′ W.; 770 fathoms; red mud. One specimen, probably ♀.

The Body is of gelatinous consistency and semitransparent; it is somewhat longer than broad, flat on the dorsum, and with the median ventral region raised into a prominent ridge, which gives the body a prismatic form (fig. 1). The *mantle-opening* appears to have been wide, and to have terminated behind the eyes; but as the integument has been torn away from the head dorsally, it is impossible to be certain of this. The *siphon* extends almost to the margin of the umbrella, and is but slightly conical, with a broad truncated extremity; internally it is provided with a distinct *valve*.

The Head is about as broad as the body; the *eyes* are rounded, and prominent laterally, the spherical lens protruding from the middle of each.

The Arms are unequal, the third pair being the largest, one quarter longer than the body, and about one-third longer than the fourth, which are slightly longer than the second, and these than the first, so that the order of length is 3, 4, 2, 1. The arms are stout, and taper gradually to blunt points. The *umbrella* extends about halfway up the dorsal arms and one-fourth up the ventral arms, its extent being intermediate between these extremes in the case of the other arms. The *suckers* are round and prominent, and in many cases show a double margin, due to a thin fold of skin surrounding the thickened edge of the sucker; they commence one sucker's breadth from the oral margin, and become gradually larger and wider apart as far as the middle of the arm, where they are one sucker's breadth apart, after which they are smaller and closer, and towards the extremity stand in contact. There is no trace of a *hectocotylus*.

The Surface of the body appears to have been perfectly smooth; it is covered with torn remains of epithelium, but there are neither warts nor cirri.

The Colour is a pale yellowish-grey, and there are numerous reddish-brown chromatophores.

Dimensions.

Length, total,	70 mm.
End of body to mantle-margin,	27 „
End of body to eye,	33 „
Breadth of body,	22 „
Breadth of head,	20 „
Eye to edge of umbrella,	19 „
Diameter of largest sucker,	1·5 „

[1] So called from the form of the body.

	Right.	Left.
Length of first arm,[1]	26 mm.	27 mm.
Length of second arm, ...	27 „	23 „ [2]
Length of third arm, ...	36 „	30 „ [2]
Length of fourth arm, ...	26 „	26 „

The genus *Japetella* was originally created for the reception of two forms, which however, differed in a character so important that they were only united provisionally. Since then the other species (*Japetella diaphana*) has been referred to *Eledonella*, Verrill, so that the present genus is monotypic. The distinguishing character is the median ventral septum in the branchial cavity, which, though present in *Octopus*, *Eledone*, *Cirroteuthis*, *Eledonella*, and *Bolitæna*, is absent in *Japetella*. The presence of a valve in the siphon is very remarkable.

This is another of the forms brought up by a trawl which had been down into deep water, and concerning whose real place of origin there is considerable uncertainty; its general similarity to *Eledonella* is so great that whatever decision is come to regarding the one, must be regarded *à priori* as probably true of the other.

Suborder II. DECAPODA, Leach.

Division I. MYOPSIDA, d'Orbigny.

Family VII. Sepiolini, Steenstrup.

Sepiola (Rondelet), Leach.

Sepiola rondeleti, Leach.

1558. *Sepiola rondeleti*, Gesner, De Aquat., lib. iv. p. 855.
1817. „ *Rondeletii*, Leach, Zool. Miscell., vol. iii. p. 138.
1839. „ „ d'Orb., Céph. acét., p. 230; Sépioles, pl. i. figs. 1–6; pl. ii. figs. 3–13; pl. iii. figs. 6–9.
1845. „ *oceanica*, d'Orb., Moll. viv., pl. x. fig. 13 (*err.*).
1853. „ *Rondeletii*, Forbes and Hanley, Brit. Moll., vol. iv. p. 220, pl. mmm. fig. 1.
1869. „ *Rondeletti*, Targ., Cef. Mus. Firenze, p. 45.
1869. „ *Rondeleti*, Jeffreys, Brit. Conch., vol. v. p. 136.
1879. „ *sepiola*, Tryon, Man. Conch., vol. i. p. 155.

Habitat.—The Minch, west coast of Scotland, "Porcupine" Expedition, 1869; 60 to 80 fathoms. Two specimens, ♀.

British Seas (Forbes and Hanley, Jeffreys); Atlantic coast of France (Fischer,

[1] The lengths of the arms are measured from the eye. [2] Mutilated.

Daniel); Mediterranean (d'Orbigny, Vérany); Adriatic (Ninni); Ægean (Forbes); Greenland (Steenstrup); Gorée, Senegal (Maltzan); Canaries (M'Andrew in Brit. Mus.).

The name by which this species has long been currently known has been called in question by Tryon (*loc. cit.*), who adopts the term *Sepiola sepiola*. According to the British Association rules, in their present form, there is no doubt that this view is correct, for the Linnean specific name takes precedence of all others, and it is not held to be necessary to change it even though it be erected into a generic name. At the same time it must be remembered that this last principle is only of modern adoption; it was the universal custom, even so lately as the first edition of the British Association rules, for any writer who converted a specific name to generic use to propose a new one in its place, and therefore Leach, when he created the genus *Sepiola*, followed the usual custom in selecting and giving currency to one taken from the pages of Gesner, who wrote in 1558. It must, of course, be understood that Gesner's designation is not a binomial name in the Linnean sense though it happens to consist of two words; it simply means to identify the animal as the one called "Sepiola" by Rondelet.

It seems best, on the whole, to perpetuate Leach's designation, 1st, because it has virtually, if not technically, the claim of priority; 2nd, because it was proposed by Leach in strict conformity with the usage of his time; and 3rd, because it has since found universal acceptance for the commonest of the Mediterranean species. According to Steenstrup [1] and others,[2] there seem to be about three of these; one of them may be identical with *Sepiola oweniana*, d'Orb.; although Tryon has referred a form from the Fiji Islands to this species.[3]

Gwyn Jeffreys' assertion (*op. cit.*, p. 137) that "the male (of this species) is *Sepiola atlantica* of d'Orbigny" is absolutely without foundation, and could only have been made in total ignorance of the sexual characters found in this genus, which were clearly set forth so long ago as 1856 [4] by Steenstrup, whom Jeffreys himself rightly describes as "one of the greatest authorities on the Cephalopods." It is parallel to his statement (*op. cit.*, p. 131) that the distinction between *Loligo vulgaris* and *Loligo forbesii* is not valid because it is possibly sexual, being based mainly on the relative sizes of the suckers, although males of both species were described.

For the specimen from Gorée I am indebted to v. Maltzan as well as for some other specimens from the same locality.

[1] Mörch, *Vid. Meddel. nat. Foren. Kjøbenhavn*, p. 101, 1867. [2] Targioni-Tozzetti, *op. cit.*, pp. 44, 45.

[3] Man. Conch., vol. i. p. 156.

[4] Hectocotyl., p. 197, and *Ann. and Mag. Nat. Hist.*, ser. 2, vol. xx. p. 91, 1857; see also Steenstrup, Sthenoteuthis og Lestoteuthis, p. 8.

Inioteuthis, Verrill.

Inioteuthis morsei, Verrill (Pl. XIV. figs. 1–9).

1881. *Inioteuthis Morsei*, Vll., Ceph. N.E. Amer., p. 417.
1884. *Sepiola bursa*, (*?*) Pffr., Ceph. Hamb. Mus., p. 6, fig. 6.
1886. *Inioteuthis Morsei*, Appellöf, Japanska Ceph., p. 15, pl. ii. figs. 15, 16; pl. iii. figs. 16, 19, 20, 23.

Habitat.—Station 233, off Kobé, Japan, May 17, 1875; lat. 34° 39′ N., long. 135° 14′ E.; 8 to 14 fathoms, mud. Four specimens, ♀.

Bay of Yedo (Verrill); Hong Kong (Pfeffer); Japan (Appellöf).

The Body is oblong, rounded behind and rather longer than broad; the *fins* are subcircular, notched at the anterior attachment to the body, but not at the posterior; they are about half as long and half as broad as the body. The *mantle* is attached to the head by a broad ligament reaching nearly the whole distance from eye to eye; the *mantle connective* is of the usual form. The *siphon* is long, slender, conical, slightly expanded at the extremity, and nearly reaches the gap between the ventral arms.

The Head is broad and the *eyes* prominent; the *lacrymal pore* below and anterior to the eye is in several specimens unrecognisable.

The Arms are unequal, the order being 2=3, 1=4; they are slightly longer than the body, conical and gradually tapering towards the extremities. The *suckers* are in four series, except a few (four to eight) proximal ones which are in two series (fig. 9), they are hood-shaped (figs. 2, 3) and oblique, with very slender peduncles from which they readily become detached. The *horny ring* is entire and surrounded by a narrow papillary area. The *hectocotylus* was not seen, all the specimens being females. The *umbrella* extends about equally between the first, second, and third arms, namely, about up to the fourth row of suckers, while between the third and fourth arms it reaches to the seventh row, and is entirely absent between the two ventral arms. The *buccal membrane* has six points, but no suckers. The *outer lip* is thin, the *inner* thick and papillate.

The Tentacles are nearly twice as long as the body, the *stem* is flattened on the inner side, rounded on the outer; the internal dorsal angle is produced into a thin membrane, which becomes wider distally. The *club* (figs. 4, 5) is elongated and but slightly expanded, it is covered for three-quarters, and near the tip over almost the whole, of its circumference with exceedingly minute suckers, which give it a velvety appearance even under a lens. The *suckers* are goblet-shaped, with a minute aperture leading into the infundibulum and a bell-shaped horny ring, the base of which is directed towards the peduncle (figs. 6–8).

The Surface is smooth all over.

The Colour is a pale yellowish-grey mottled with dull purple, the spots being more distinct on the ventral surface of the body, fins, and arms. There are four or five oval patches on the outer side of the tentacle near the club.

The Gladius is absent.

Dimensions.

Length, total,	120 mm.
End of body to mantle-margin,	40 „
End of body to eye,	45 „
Breadth of body,	28 „
Breadth of head,	25 „
Eye to edge of umbrella,	15 „
Length of fin,	22 „
Breadth of each fin,	15 „
Breadth across the fins,	57 „

	Right.	Left.
Length of first arm,	38 mm.	35 mm.
Length of second arm,	50 „	50 „
Length of third arm,	50 „	50 „
Length of fourth arm,	38 „	40 „
Length of tentacle,	65 „	70 „
Length of tentacular club,	15 „	15 „

I have thought it well to give a full description and figures of this form because its identity with that described by Dr. Pfeffer is not quite certain. The diagnosis of the latter agrees with the Challenger specimens in every particular, but no mention is made of the remarkable structure of the tentacular suckers; Dr. Pfeffer, to whom I wrote on this matter, does not seem, however, to have made a microscopic examination of them, without which their peculiarities would be quite unnoticed. Having several specimens at my disposal, I removed a piece of the integument with the suckers attached and mounted it in Canada balsam, and from this preparation the figures 6, 7, and 8 on Pl. XIV. were drawn. I am inclined on the whole to think that the species are identical, and Dr. Pfeffer's name was therefore at first applied to the Challenger specimens, and printed at the foot of the plate.

In the absence of males there seems to be no point separating the present form from Verrill's *Inioteuthis*,[1] also from Japan; indeed, so far as females are concerned, this genus would seem to differ only from *Sepiola* in the absence of the gladius, and should perhaps contain several species which have been referred to the latter. Verrill does not say how he identified his type with *Sepiola japonica*, Tilesius, which I have always regarded as one of those Cephalopods concerning which no certain information was to be had; and his description omits the most characteristic point in that of d'Orbigny,[2] namely, the "tendon," which forms an elevated rounded tubular muscle lying between

[1] *Trans. Connect. Acad.*, vol. v. p. 417.

[2] Moll. viv., p. 251.

the two rows of suckers. It would be interesting to know what is the structure of the tentacular suckers in this form.

The original description of *Inioteuthis morsei* (*loc. cit.*) is very brief, and would fit *Sepiola bursa* very well, except that it is not mentioned that the proximal suckers are in two series. The uncertainty at present existing among these various species can only be cleared up by their respective authors giving full particulars regarding the points alluded to above.[1]

Sepiola stenodactyla, Grant,[2] recalls this species by the description of its tentacular clubs, which "present a villous appearance but have no suckers developed;" judging by the figures, however, it has a shorter, more rounded body and longer arms, and the eight series of suckers would be quite diagnostic if this character could be relied upon. This is very doubtful, however, because the description speaks of seven or eight rows very irregularly placed, and because no *Sepiola* has yet been found with other than four distinctly marked series of suckers.

The extreme contraction of the mouth of the horny ring in the tentacular suckers is a point of great interest, especially when taken in connection with the absence of any roughnesses or papillæ on the suctorial surface. It seems to indicate that they adhere by almost pure suction in contradistinction to those of most Decapods, which adhere by a combination of suction with the action of the toothed margin of the ring and the horny papillæ surrounding it.[3]

Rossia, Owen.

Rossia oweni, Ball (Pl. XV. figs. 1–9).

1842. *Rossia Owenii* et *Rossia Jacobii*, Ball, Proc. Roy. Irish Acad., vol. ii. p. 193.
1842. „ „ „ „ Ball, Ann. and Mag. Nat. Hist., vol. ix. p. 349.
1844. *Rossia Oweni* et *Rossia Jacobi*, Thompson, Rep. Brit. Assoc., p. 248.
1845. *Rossia Owenii* et *Rossia Jacobii*, d'Orbigny, Moll. viv. et foss., p. 259.
1845. „ „ Lovén, Öfversigt k. Vetensk. Akad. Förhandl., p. 121.
1849. „ „ Gray, B. M. C., p. 90.
1853. „ „ Forbes and Hanley, Brit. Moll., vol. iv. p. 223, pl. sss, fig. 1.

Habitat.—Off the Butt of Lewis, H.M.S. "Triton," August 25, 1882; 40 fathoms. Three specimens, ♀.

The Minch, H.M.S. "Porcupine," 1869. One specimen, ♀.

Off Wexford, H.M.S. "Porcupine," 1869. One specimen, ♂.

[1] Since these remarks were in type, I have received Appellöf's interesting Memoir on Japanese Cephalopoda, and his description has left no doubt in my mind that the Challenger specimens are of the same species as those which he has named *Inioteuthis morsei*, Verrill; I have, therefore, at the moment of going to press adopted that name in the text of this Report. The absence of males in the collection is greatly to be regretted, as a comparison of the peculiar hectocotylised arm would have rendered the identification still more satisfactory.

[2] *Trans. Zool. Soc. Lond.*, vol. i. p. 84, pl. ii. figs. 1, 2.

[3] Niemiec, *Recueil zool. suisse*, t. ii. p. 190.

Off Dublin Bay (Ball); Isle of Wight (Forbes and Hanley); Firth of Clyde (Scottish Marine Station); Kattegat (Copenhagen Museum); "ad oras Bohusiæ" (Lovén).

"Rossia Owenii Ball? Ann. nat. hist. IX, 349; pinnis pone medium sitis, brachiis basi discretis, acetabulorum inæqualium serie tri-quadruplici armatis, tentaculis validis, membrana apicali ad basin tori incipiente.—Abdomen ventricosum, satis obtusum, latit. ad longit. = 28:38. Pinnæ ad basin longitudine abdominis dimidium prope æquantes, late ellipticæ, antice per breve spatium limbi liberæ. Caput magnum. Brachia valida, 1, 4, 2, 3, ad basin brevissime colligata, exceptis 3tiis, quæ ad $\frac{1}{6}$ longit. 4tis adnexa, his invicem profunde discretis. Acetabula, quorum in brachii singuli serie laterali circ. 30, inde ab ima basi numeranda, inferius per paria disposita subalterna, deinde per series obliquas tri- et quadruplices, brevissime pedunculata (nec longe, cfr. l. c.), in brach 1:is subæqualia, mediocria, in 4:is, 2:is, et præsertim 3:iis inæqualia, lateralibus media duplo superantibus. Brachia 1 latere externo plica cutis marginali. Tentacula valida, compressa, corpus longitudine æquantia, apice dilatata, revoluta, et intus toro prædita lanceolato, membrana utrinque defenso, ex acetabulis confertis, versus apicem sensim diminutis, superioribus baseos longe maximis, basalia brachii 1:mi vix credentibus; membrana marginalis ad basin tori incipiens. Palpebra crassa, inferior oculum omnino obtegens. Long. tot. = 85 mm.; ad basin brach. 1 = 58 mm.; latit. max. = 28 mm.; long. gladii 23 mm.—Ad oras Bohusiæ hieme semel capta."—(Lovén, *loc. cit.*).

There can be little doubt that as Steenstrup has suggested,[1] the two forms described by Ball are of different sexes and not of different species, although it is not true as stated by Jeffreys[2] that he "considers *R. Owenii* of Ball the male, and his *R. Jacobii* the female of *R. macrosoma*." The distinguishing characters indicated by Ball are exactly those which mark out the sexes; the males have enlarged suckers in the two outer series on the lateral arms, while the females have smaller equal suckers, and the body is more elongated, or, what is the same thing, the arms are "proportionably shorter." The description of the membrane round the mouth given in connection with *Rossia jacobii* is not of the nature of a specific character, being found in many, if not most, genera of Decapoda.

This species is very closely related to several others, many of the distinctive characters being only of a relative nature, as indeed is the case throughout the genus. It differs from *Rossia palpebrosa*, Owen, in the greater equality of the arms and the more posterior position of the fins; it resembles *Rossia hyatti*, Verrill, very closely in many respects (form of body, proportionate length of arms and umbrella, and number of rows of suckers), but the fin is different in shape, wider, and less incised anteriorly, and there are no papillæ on the dorsal surface.

This species is certainly very closely allied to *Rossia macrosoma*, and should

[1] Hectocotyl., p. 199.

[2] Brit. Conch., vol. v. p. 134.

perhaps be regarded as only a variety of it; still it seems quite easy to distinguish well-grown specimens of the two species from each other, as follows :—

Rossia oweni.	*Rossia macrosoma.*
1. Attains rather greater dimensions, in the largest specimen in my collection (♀) the length of the body is 50 mm.	1. In the largest specimens I have seen the length of the body was from 30 to 35 mm.
2. The body is more elongated, the breadth being 55 to 65 per cent. of the length.	2. The breadth is 70 to 75 per cent. of the length.
3. The tentacles are shorter.	3. The tentacles are longer.
4. The tentacular suckers are slightly larger.	4. The tentacular suckers are not quite so large.

The most accurate of the descriptions published is that of Lovén quoted above, the original diagnosis of Ball being extremely incomplete and misleading in the statement that the suckers are in three rows; they are really in four, but sometimes (especially in the males) so irregular that on casual inspection only three seem to be present.

The only figure of this species hitherto published is that of Forbes and Hanley (*loc. cit.*) which leaves much to be desired; the tentacular club in particular is very inaccurate (compare Pl. XV. fig. 6 with pl. sss.). The central figure of Pl. XV. is taken from a fine specimen (♀) obtained by H.M.S. "Porcupine," while figures 2 and 5 are from a male captured off Wexford, the only specimen of that sex which has come into my hands. The teeth of the large tentacular suckers are very irregular (see figs. 7 and 9); the papillary area which immediately surrounds the horny ring consists of two rows of obliquely truncated conical papillæ (seen in profile in fig. 8), outside which is a layer of chitinous material with somewhat irregular closely set radial markings.

This species would seem, judging from the literature of the subject, to be rather rare, each of the previous observers having recorded only one specimen, but several unrecorded examples are in the Museums of Copenhagen and Gotheborg, and there can be little doubt that it would have been much more frequently mentioned had it not been wrongly identified with *Rossia macrosoma*. A considerable number of specimens were trawled last summer by the "Medusa" during the sojourn of the Scottish Marine Station at Millport in the Firth of Clyde.

Rossia glaucopis, Lovén.

1845. *Rossia glaucopis*, Lovén, Öfversigt k. Vetensk. Akad. Förhhandl., p. 121.
1869. *Rossia papillifera*, Jeffreys, Brit. Conch., vol. v. p. 134.
1878. *Rossia glaucopis*, Sars, Moll. Reg. Arct. Norv., p. 337, pl. xxxii.

Habitat.—Station 65, north west of the Shetland Islands, cruise of H.M.S. "Porcupine," 1869; lat. 61° 21′ N., long. 3° 44′ W.; 345 fathoms. One immature specimen.

Near Hammerfest, 40 to 50 fathoms (Lovén); north of the Shetlands, 60 to 100 fathoms (Jeffreys); Lofoten and Finmark, not very uncommon at depths of 60 to 200 fathoms (Sars).

An example from the Shetlands enables me to corroborate in the most satisfactory manner the opinion expressed by Professor Sars that *Rossia papillifera* is a synonym of *Rossia glaucopis*. It was contained in a bottle sent to me among the "Porcupine" collection, and had been labelled with the former designation by Jeffreys, while on a separate label it bore the name *Rossia glaucopis*, in the handwriting of Professor Steenstrup, who had examined it along with the remainder of the collection. Professor Steenstrup tells me, moreover, that, from the notes he received along with the "Porcupine" specimens from Jeffreys, he has every reason to believe that this particular individual was the type of *Rossia papillifera*.

I have also compared it myself with specimens of Lovén's species from Lofoten sent to Sir Wyville Thomson by Professor Sars and can find absolutely no points of specific distinction between them.

Rossia sublevis (?), Verrill.

1878. *Rossia sublevis*, Vll., Amer. Journ. Sci. and Arts, vol. xvi. p. 209.
1879. „ „ Tryon, Man. Conch., vol. i. p. 160.
1880. „ „ Vll., Amer. Journ. Sci. and Arts, vol. xix. p. 291, pl. xv. fig. 3.
1881. „ „ Vll., Bull. Mus. Comp. Zoöl., vol. viii. p. 104, pl. iii. figs. 2–4, pl. vii. fig. 4.
1881. „ „ Vll., Ceph. N. E. Amer., pp. 354, 419, pl. xxx. fig. 2, pl. xxxi. fig. 3, pl. xlvi. fig. 4, pl. xlvii. figs. 2–4.

Habitat.—Station 313, off Cape Virgins, South America, January 20, 1876; lat. 52° 20′ S., long. 67° 39′ W.; depth, 55 fathoms; sand. One small somewhat damaged specimen, ♀.

Eastern coast of the United States, from Nova Scotia as far south as lat. 32° 33′ 15″ N.; depth, 42 to 640 fathoms (Verrill).

A large number of specimens of *Rossia patagonica*, E. A. Smith, were obtained from the same Station, and it is quite possible that the present may be only a young form of that species; it differs, however, in the shorter and more rounded form of its body, in the longer and narrower pit at the base of the siphon for articulation with the mantle, and in the more elongated tentacular club, and on the whole seems to present greater resemblance to Verrill's species, to which I have, not without hesitation, referred it. If the identification be correct its occurrence so far south is a matter of some interest.

Rossia (*?*) *tenera* (Verrill), mihi.

1880. *Heteroteuthis tenera*, Vll., Amer. Journ. Sci. and Arts, vol. xx. p. 392.
1880. „ „ Vll., Proc. Nat. Hist. Mus., vol. iii. p. 360.
1881. „ „ Vll., "Blake" Rep., vol. viii. p. 103, pl. iii. fig. 5; pl. vii., figs. 2, 3.
1881. „ „ Vll., Ceph. N. E. Amer., p. 357, pl. xlvi. figs. 2, 3; pl. xlvii. fig. 5.
1883. „ „ Vll., "Blake" Suppl., p. 111.

Habitat.—Station 49, south of Halifax, Nova Scotia, May 20, 1873; lat. 43° 3′ N., long. 63° 39′ W.; 85 fathoms; gravel, stones. One specimen, ♀.

Off the New England Coast, 18 to 301 fathoms; off St. Kitts (Verrill).

A small specimen dredged south of Halifax agrees so well with Professor Verrill's *Heteroteuthis tenera* that there can be little doubt as to its correct reference to that species. The differences noticed are, the greater shortness of the ventral arms, which are subequal to the dorsal and shorter than the lateral, whilst on the tentacular club the disparity between the sizes of the suckers is not so marked as in Verrill's figure (pl. xlvi. fig. 2*a*), and the suckers are more numerous, especially towards the proximal end of the club.

Having only a single small specimen at my disposal I did not remove the pen nor the buccal organs.

I cannot, however, agree with Verrill in referring this form to *Heteroteuthis*, Gray, because the type of that genus (*Rossia dispar*, Rüppell), is a very different animal. Among its points of distinction may be mentioned the following:—

1. The fins are placed very far back, projecting beyond the hinder end of the body, as in Verany's figures.[1]

2. The anterior border of the mantle is of quite a different shape, being transverse dorsally, coming forward on either side below the eye and having a notch for the reception of the funnel.

3. The length of the gladius is only one-sixth of the length of the body,[2] while in *Rossia tenera* it is nearly half as long.[3]

4. The enormously large suckers are three or four in number and are situated on the third pair of arms.[4]

5. The dorsal and dorso-lateral arms are united for half their length by a web, and at their conjoined bases on the right side is situated the gland first described by Troschel.[5]

These points I have been able to substantiate by the examination of two male

[1] Céph. médit., pl. xxiii. figs. *d*, *e*, *f*.
[2] Stp., Sepiadarium og Idiosepius, p. 217.
[3] Compare Ceph. N. E. Amer., pl. xlvi. figs. 2 and 2*b*.
[4] Troschel, *Archiv f. Naturgesch.*, Jahrg. xxiii. Bd. i. p. 63; Claus, *op. cit.*, Jahrg. xxiv. Bd. i. p. 259.
[5] *Loc. cit.* Troschel also points out and rectifies Vérany's erroneous statement that it is the females and not the males which are provided with large suckers.

specimens, presented to the British Museum by Rüppell and recorded by Gray in his Catalogue;[1] they leave no doubt that Verrill's *Heteroteuthis* is not that of Gray, and indeed the form described by him does not seem to me to differ so much from other species of *Rossia* as to demand the erection of a new genus for its reception.

Rossia patagonica, E. A. Smith (Pl. XV. figs. 10–18).

1881. *Rossia patagonica*, E. A. Smith, Proc. Zool. Soc. Lond., p. 22, pl. iii. fig. 3.

Habitat.—Station 313, off Cape Virgins, South America, January 20, 1876; lat. 52° 20′ S., long. 67° 39′ W.; 55 fathoms; sand. Twenty-six specimens, 11 ♂, 15 ♀.

Southern Patagonia, 10 and 30 fathoms (E. A. Smith).

Dimensions.[2]

Length, total,	59 mm.
End of body to mantle-margin,	22 „
End of body to eye,	27 „
Breadth of body,	17 „
Breadth of head,	19 „
Eye to edge of umbrella,	8 „
Length of fin,	19 „
Breadth of fin,	9 „
Breadth across both fins,	34 „
Diameter of largest sucker on sessile arm,	2 „
Diameter of largest sucker on tentacle,	0·5 „

	Right.	Left.
Length of first arm,	22 mm.	22 mm.
Length of second arm,	27 „	27 „
Length of third arm,	27 „	28 „
Length of fourth arm,	21 „	21 „
Length of tentacle,	32 „	32 „

The following notes may be given as supplementary to Mr. E. A. Smith's description.

All the arms in both sexes have two series of suckers, except at the extreme tip, where there are four series of very minute ones. The male has the suckers (figs. 14, 18) on the lateral and ventral arms, enlarging rapidly to the middle of the arms and then diminishing (figs. 10–12) their size being three times as great as in the females. The left dorsal arm (fig. 13) is hectocotylised; it has two series of suckers except at the extreme tip, where there are four as usual, and in the middle of the arm the two series assume a zigzag arrangement so as to present the appearance of four. The suckers are

[1] B. M. C., p. 90.

[2] Taken from the largest specimen, a male; the lengths of the arms are measured from the centre of the eye.

mounted upon long conical peduncles, whose bases are curved outwards, and a broad membrane passes up the lateral aspect of the arm for about three quarters of its length.

The tentacular suckers (figs, 16, 17) are largest at the inner border of the club, and there they are bounded by a narrow protective membrane, beyond which is a fin about one-third as broad as the club.

Promachoteuthis,[1] Hoyle.

Body short, rounded, with large broad *fins*, situated posteriorly. *Mantle* free behind, as in *Rossia*; *siphon* short, slender, and with everted margin; valve?

Head small and narrow; *eyes* not prominent.

Arms long and conical, with two series of pedunculate spherical *suckers*. *Tentacles* exactly resembling the arms at their origin; their extremities wanting in the only specimen.

Gladius not removed from the single example.

The definition of this new genus must be regarded as provisional; the only known species being represented by a single specimen, in describing which all that is known about the genus will be stated.

Promachoteuthis megaptera, Hoyle (Pl. XIV. figs. 10–14; woodcut 3).

1885. *Promachoteuthis megaptera*, Hoyle, Narr. Chall. Exp., vol. i. p. 273, fig. 109.
1885. „ „ Hoyle, Diagnoses II., p. 182.
1885. „ „ Hoyle, Prelim. Rep. II., p. 284.

Habitat.—Station 237, south-east of Nosima, Japan, June 17, 1875; lat. 34° 37′ N., long. 140° 32′ E.; 1875 fathoms; blue mud. One mutilated specimen, sex?

The Body is short, barrel-shaped, rounded behind; the *fin* is large, transversely elliptical, and extending beyond the end of the body posteriorly; each half is wider than long. The *mantle-margin* is transversely truncated. The *mantle-connective* consists of a linear ridge on either side, fitting into an almond-shaped depression at each side of the base of the *siphon* (fig. 11), which is short, slender, and has the distal margin everted, like the neck of a flask; the specimen was so small and indifferently preserved that the siphon was not opened to ascertain whether a valve was present.

The Head is very small and narrow, almost the whole of its sides being occupied by the *eyes*, which are not prominent, but are covered with a transparent membrane, and have a distinct pore at a point in front of and below each (fig. 10).

[1] In forming this name I have ventured to make use of Dr. Carpenter's very apt rendering of "Challenger" by *πρόμαχος* (Narr. Chall. Exp., p. 311).

The Arms are unequal, the fourth pair being the shortest (considerably so on the right side); the first, second, and third are subequal; they are on an average of about the same length as the body, smoothly conical, and taper evenly to fine points. The *suckers* (fig. 14) are in two series throughout, pedunculate, spherical, with a lateral aperture directed inwards (figs. 11, 12); the *horny ring* is smooth and surrounded by a few large papillæ. The *hectocotylus* is not developed. There is no trace of an *umbrella*. The *buccal membrane* is well developed and has the usual seven points, but they are not very well marked nor provided with suckers; the membrane is not connected with the arms by ligaments. There seems to be only one *lip*, which is thick and papillate (fig. 13).

Fig. 3.—*Promachoteuthis megaptera*, Hoyle; natural size.

The Tentacles arise directly between the third and fourth arms, exactly resembling them at their origin, and being obviously serially homologous with them (figs. 10, 13); the *stem* is swollen at first and somewhat more than one third up the arms narrows rather suddenly to about half its previous diameter. The *club* is wanting in the unique specimen.

The Surface is smooth.

The Colour is a dull purplish madder, paler on the fins (especially their under surface) and on the arms and tentacles.

The Gladius has not been extracted.

Dimensions.

Length, total (to end of mutilated tentacle),	50 mm.
End of body to mantle-margin,	15 „
End of body to eye,	18 „
Breadth of body,	9 „
Breadth of head,	6 „
Length of fin,	11 „
Breadth across both fins,	23 „
Diameter of largest sucker on sessile arm,	0·75 „

	Right.	Left.
Length of first arm,	13 mm.	14 mm.
Length of second arm,	14·5 „	15 „
Length of third arm,	14 „	14 „
Length of fourth arm,	7 „	12 „
Length of tentacle (mutilated),	22 „	25 „
Number of suckers on first arm,	37	37
Number of suckers on second arm,	39	39
Number of suckers on third arm,	35	39
Number of suckers on fourth arm,	20	31

The single specimen upon which the genus and species under discussion are based was in a most unsatisfactory condition; the head was separated from the body and the latter was completely gutted, only the integuments remaining. Under these circumstances its relationships to other forms can only be incompletely made out. It seems, however, to be connected in some way or other with all the principal groups of Myopsida.

With *Sepiola* and *Rossia* it agrees in the form of the body and fins (although these are situated much farther back, and even extend beyond the posterior extremity of the body) as also in the spherical form of the suckers. It resembles the latter genus in that the mantle fold seems to have been continuous across the dorsum.

From both these genera it differs in the small size of the head, which is considerably less in diameter than the body, and also in the covering of the eye, the integument passing directly over this without any reduplication to form a lower eyelid; in the last point it resembles *Loligos* as also in the presence of the pre-ocular pore, but whether it also agrees with that genus in the presence of an auricular crest cannot now be determined. A relationship to *Sepia* is indicated by the form of the mantle-connective, which consists of an almond-shaped depression at the hinder angle of the siphon, and not of an elongated groove, as in the other genera just mentioned.

Finally, the similarity between the tentacles and the arms, alluded to above, may perhaps be a primitive character; it has also been observed in *Taonius suhmi* (see p. 192).

Family VIII. SEPIARII, Steenstrup.

Subfamily IDIOSEPII, Steenstrup.

Spirula, Lamarck.

Spirula peronii, Lamarck.

1822. *Spirula peronii*, Lmk., Anim. s. Vert., t. vii. p. 601.

Habitat.—Station 194A, off Banda, September 29, 1874; lat. 4° 31′ S., long. 129° 57′ 20″ E.; 360 fathoms; volcanic mud. One specimen, with soft parts.

North Atlantic, April 29, 1876, surface. Dead shells.

Raine Island, Torres Strait. Dead shells from the shore.

Station 216A, north of Papua, February 16, 1875; lat. 2° 56′ N., long. 134° 11′ E.; 2000 fathoms; Globigerina ooze. One dead shell with a Cirriped attached (almost certainly from the surface).

February 22, 1875; 70 miles north-east of Fort D'Urville, Papua. Dead shell.

Since Professor Huxley is preparing a Report on this genus, I have merely recorded the localities at which its occurrence was observed during the Expedition.

Subfamily Eusepii, Steenstrup.

Sepia, Linné.

One of the most marked accessions of new species has been to this already large genus, which has been augmented to the extent of no less than ten new types as the result of the Challenger Expedition. It is noteworthy, moreover, that all these were obtained between Port Jackson, Australia, and Japan, a fact which will be again alluded to when treating of distribution (see p. 222).

The species of this genus being very numerous and differing only in minute, though to all appearance constant characters, it has been necessary to enter into considerable detail in their descriptions, and the more so, inasmuch as the accounts of nearly all the earlier writers have left much to be desired in this respect. This is the case especially with respect to the shell or sepiostaire, regarding the different parts of which no settled terminology seems to have been adopted, even by those writers who have most clearly recognised its systematic importance. I have therefore found it necessary to adopt a series of names for descriptive purposes, and have endeavoured to select those which should be convenient, readily suggestive of the structures to which they refer, and devoid of any abstract morphological significance with regard to their origin or homology. The annexed woodcut shows the names chosen, with respect to one or two of which it may be advisable to make some observations.

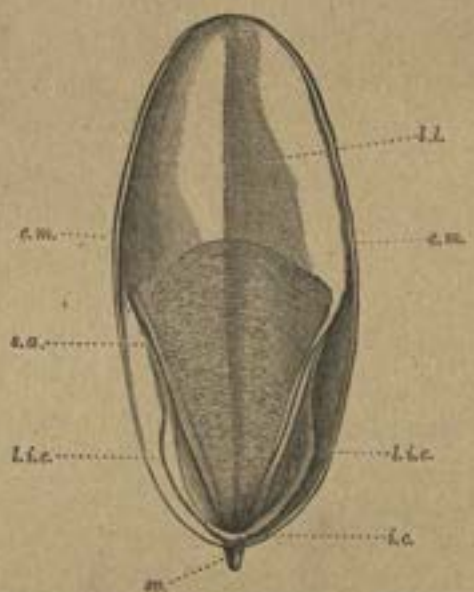

Fig. 4.—Shell of *Sepia mestus*, Gray, showing the terms used in describing different parts of it. *c.m.*, chitinous margin; *l.c.*, inner cone; *l.l.c.*, limbs of the inner cone; *l.l.*, last loculus; *s.a.*, striated area; *sp.*, spine.

The *last loculus* is a term borrowed from d'Orbigny, who adopted it for the most recently deposited calcareous layer; the proportion which it bears to the area of the shell is very characteristic, and appears to be constant within certain limits. Professor Steenstrup informs me that it varies according to the season of the year. This relation is for practical purposes most conveniently expressed by dividing the total length of the shell into one hundred parts, and stating how many of them are occupied by it; this quantity I propose to designate briefly as the "locular index."

The hinder generally hollow ventral surface of the shell I have called the "striated area"; valuable characters are derived from the curvature of the parallel lines formed by the margins of the loculi.

In most shells a thin fillet of calcareous matter runs along either side of this area,

and posteriorly these two fillets unite and often form a little pointed space into which the hinder end of the visceral sac is received; this I have called the "inner cone," because in many cases the margin of the shell proper forms a larger more or less complete cone outside this, which is called the "outer cone." (See Pl. XXI. figs. 14, 15.) The two fillets above described will be alluded to as the "limbs of the inner cone."

The suckers, also, in this genus offer valuable characters for the discrimination of species; they are always pedunculate and obliquely set, as in most Decapoda, but the horny ring surrounding the acetabular cavity may be either smooth or more or less coarsely toothed. Steenstrup has pointed out that this denticulation is in some cases subject to a sexual variation, so that in instituting comparisons between different forms in respect of this character, care must be taken not to use different sexes. The ring is commonly surrounded by an area in which the epidermal cells are surmounted by rough plates of a chitinous material; this I propose to call the "papillary area." The relative sizes and shapes of its component parts vary in different species, and in many cases I have figured them. Furthermore, the margin of the sucker itself is in many species marked by a number of narrow grooves, separating more bulging intermediate portions; these, from their direction, will be called "meridional grooves," and will be alluded to in those cases in which their presence has been observed.

The structure of the hectocotylised arm has been described and figured, wherever it was present; and so far from this being uniform throughout the genus, no less than four different types of modification have been observed. It is very unfortunate that we have accurate information on this point in so few forms of this genus, for there is no doubt that it would afford a most valuable character in the discrimination of species.

I regret that I have been unable in the present work to adopt the divisions of the genus proposed by Dr. de Rochebrune in his recent "Étude monographique;"[1] from some of his conclusions I am obliged to differ entirely, as for example the separation of *Diphtherosepion ornatum* (Rang), from the genus *Sepiella*, and having been unable to go fully into the whole question it appeared to me better to leave the genus intact, except in so far as specimens, which I have myself examined, seemed to require a different treatment.

Sepia smithi,[1] Hoyle (Pl. XVI. figs. 1–12).

1885. *Sepia Smithi*, Hoyle, Diagnoses I., p. 190.
1885. „ „ Hoyle, Prelim. Rep. I., p. 294.

Habitat.—Station 188, Arafura Sea, south of Papua, September 10, 1874; lat. 9° 59′ S., long. 139° 42′ E.; 28 fathoms; green mud. Four specimens, ♀.

[1] *Bull. Soc. Philom. Paris*, sér. 7, t. viii. pp. 74–122, pls. iii.–vi.

[2] Named after Mr. Edgar A. Smith, F.Z.S., of the British Museum, whose investigation of the collections made by H.M.S. "Alert," has made us acquainted with several new and interesting Cephalopods.

The Body is of medium breadth, widest one-third back, curving evenly to a pointed posterior extremity. The *fin* is nearly one-third the breadth of the body, extending from the anterior margin of the mantle to within 4 mm. of its fellow at the posterior extremity. The *mantle-margin* projects to a considerable extent over the head dorsally, and is slightly emarginate ventrally. The *siphon* is long, reaching up to the interspace between the ventral arms.

The Head is of medium breadth and the *eyes* prominent.

The Arms are subequal, their order of length being 4, 3, 2, 1; they are a little more than half as long as the body; the dorsal are the smallest and subconical, the ventral wide and with a narrow web on the outer aspect; they all taper gradually to fine points. The *suckers* (figs. 6, 7) are in four series throughout, pedunculate, oblique, notched proximally and distally, and with meridional grooves on the margin; the *horny ring* has about twenty blunt triangular teeth on the distal semi-circumference, and is surrounded by a broad papillary area (fig. 7). The *hectocotylus* was not observed, all the specimens being females. The *umbrella* is but slightly developed, reaching in its greatest extent (between the third and fourth arms) only to the fourth row of suckers. The *buccal membrane* has the usual seven points, but there is no *spermatic pad*. The *outer lip* is moderately thick and longitudinally ribbed; the *inner* is provided with many rows of elevated rounded papillæ.

The Tentacles are about as long as the mantle, and have stout three-sided *stems;* the *club* occupies about one-fourth of the whole length, and extends fully half round the stem (fig, 3); a protective membrane is found at either side of the suckers and a web along the dorso-median aspect of the club (fig. 4). The *suckers* are very numerous, minute, and closely packed; the *horny ring* has about eight or ten stout distant teeth on the distal margin (fig. 8).

The Surface is for the most part smooth, but there are about five elongated elevations down each side of the body near the origin of the fin, and a few minute papillæ on the dorsal surface.

The Colour is a dull purplish-grey above, pale ochre below.

The Shell is roughly elliptical in *outline* (figs. 10, 11, 12); the anterior extremity is bounded by two nearly straight lines forming a blunt rounded angle; the sides curve evenly outwards (the greatest breadth being a little anterior to the middle) and form a bluntish point behind. The *chitinous margin* is narrow and vanishes in the median ventral line behind. The *dorsal surface* is rough, with granules arranged in rows parallel to the anterior margin; three slightly elevated tracts diverge from the spine to the three anterior angles (fig. 12). The *ventral surface* is little elevated; the *last loculus* has an index of 29·5, and is emarginate behind, being bounded by a more or less evenly curved line; the *striated area* is excavated, so that the whole shell is thin; the *inner cone* is well developed, with a thickened rounded margin, and encloses a deep

pit; the limbs extend halfway along the striated area. The *spine* is long, tapering, and curves gently upwards.

Dimensions.

Length, total,	119 mm.
End of body to mantle-margin,	70 „
End of body to eye,	70 „
Breadth of body,	35 „
Breadth of head,	30 „
Eye to edge of umbrella,	20 „
Breadth of fin,	10 „
Diameter of largest sucker on sessile arm,	1 „
Length of shell,[1]	84 „
Breadth of shell,[1]	30 „

	Right.	Left.
Length of first arm,[2]	24 mm.	24 mm.
Length of second arm,	25 „	25 „
Length of third arm,	26 „	26 „
Length of fourth arm,	32 „	32 „
Length of tentacle,	...	72 „
Length of tentacular club,	...	18 „

The shell of this species somewhat resembles that of *Sepia aculeata*, but the animal has no suckers on the buccal membrane; it is also like d'Orbigny's figure of *Sepia indica*, but it has a shallower groove along the middle of the ventral surface, and the striations are less wavy than his description would appear to indicate; in addition to which the teeth on the suckers of the sessile arms are different.[3]

The body of one specimen had a lank, lean appearance as compared with the others, suggesting the idea that it might be a male; on examination, however, it proved to be a female which had recently deposited its eggs.

Sepia papuensis, Hoyle (Pl. XVI. figs. 13–23).

1885. *Sepia papuensis*, Hoyle, Diagnoses II., p. 197.
1885. „ „ Hoyle, Prelim. Rep. II., p. 301.

Habitat.—Station 188, in the Arafura Sea, south of Papua, September 10, 1874; lat. 9° 59′ S., long. 139° 42′ E; 28 fathoms; green mud. Two specimens, ♀.

The Body is elongated, broadest about one-third back, pointed behind: the *fins* extend the whole length of the body and are one-third of its breadth, a little wider

[1] From a larger specimen.
[2] Measured from the margin of the mouth.
[3] It is proper to mention here that, as Steenstrup has already pointed out, a confusion apparently inexplicable exists between d'Orbigny's species, *Sepia rostrata* and *Sepia indica;* the descriptions given by him disagree in many points with the figures on his plates, and there is no evidence to show whether plates or text should be accepted as the ultimate criterion; Dr. de Rochebrune in his recent Memoir has not touched upon these discrepancies.

behind; they extend to within 1 mm. of the anterior margin, but are separated by about 5 mm. posteriorly: the *mantle-margin* projects far over the head dorsally, and is slightly emarginate ventrally. The *siphon* is conical, reaching two-thirds up to the gap between the ventral arms.

The Head is short and broad; the *eyes* prominent.

The Arms are subequal, their order of length being 4, 3, 1, 2; they are about one-fourth as long as the body and taper to fine points: the dorsal are conical with a very slight ridge up the outer aspect, the third pair have a similar ridge; the ventral are flattened and bear a distinct crest. The *suckers* (figs. 19, 20) are in four series throughout and of moderate size, set obliquely on short peduncles, with meridional grooves on the outside: the *horny ring* bears twenty to twenty-five long, square-cut, irregular teeth on its distal semicircumference (fig. 20), and outside it is an area covered with closely set papillæ. The *hectocotylus* was not observed, both the specimens being females. The *umbrella* is slight, reaching only as high as the sixth row of suckers between the third and fourth arms, where it is widest; as usual it is entirely absent between the two ventral arms. The *buccal membrane* has the usual seven points. The *spermatic pad* is not developed; the *outer lip* is smooth, except for a few ridges due to contraction; the *inner* bears numerous small papillæ.

The Tentacles are about as long as the body, the *stem* being three-sided: the *club* is short, flattened, and expanded, with a protective membrane on either side and a broad web down the back, reaching along the stem for a distance equal to half the length of the club (fig. 15); it bears six larger *suckers* in the central row, a series of smaller ones on either side, and some very minute ones along each margin: at the top are fifteen to twenty in four series. The *horny ring* of the large suckers has twenty-five to thirty teeth in its distal semicircle (fig. 18); those of the smaller about ten.

The Surface is smooth, except for a few irregular inconstant papillæ on one side of the ventral surface and below the eye.

The Colour is a pale yellowish-grey, darker above.

The Jaws are shown in figs. 16, 17.

The Shell (figs. 21, 22, 23) is oval in *outline*, broadest anteriorly to the middle, tapering somewhat rapidly and ending in a semicircle in front; posteriorly it tapers gently, and, then rounding off, ends in two almost straight lines, which meet at a right angle at the base of the spine. The *chitinous margin* is but slightly uncovered on the *dorsal surface*, which shows two grooves diverging as they pass forwards, separating three ribs, and is covered with rounded papillæ arranged in curves parallel to the anterior margin. The *ventral surface* has a rather deep and broad median groove: the *last loculus* has an index of 34, and is bounded posteriorly by a wavy line with three curves; the *striated area* is hollowed, so that this part of the shell is thin; the

inner cone commences by two limbs, which arise halfway along the striated area, curve outwards, and are united below the posterior apex by a broad chitinous band passing from one side of the shell to the other and forming a rather deep *outer cone:* the *spine* is short (but has been broken off); it bends slightly upwards and has a narrow longitudinal keel on its ventral surface.

Dimensions.

Length, total,	90 mm.
End of body to mantle-margin,	64 „
End of body to eye,	60 „
Breadth of body,	28 „
Breadth of head,	26 „
Eye to edge of umbrella,	12 „
Breadth of fin,	7 „
Diameter of largest sucker on sessile arm,	0·75 „
Length of shell,	64 „
Breadth of shell,	22 „

	Right.	Left.
Length of first arm,	20 mm.	19 mm.
Length of second arm,	20 „	18 „
Length of third arm,	20 „	21 „
Length of fourth arm,	23 „	22 „
Length of tentacle,	...	50 „

This species agrees very closely with *Sepia singaporensis,* Pfeffer,[1] as regards the soft parts, but the shell is broader at the anterior extremity and the spine cannot be said to be "zurück gebogen," although it slopes gently upwards; it is also near to *Sepia plangon,*[2] Gray, which seems, however, to be still nearer to Dr. Pfeffer's species.

It corresponds with an unnamed shell in the Copenhagen Museum.

The smaller specimen has the curve bounding the loculi even, not wavy, and the keel upon the spine is more distinct than in the other specimen.

[1] Ceph. Hamb. Mus., p. 10, fig. 13.,

[2] *Sepia plangon*, Gray. The type specimen in the British Museum has the following characters:—The *body* is moderately long and oval in form; the *fins* are very narrow but seem to have been partially destroyed; they commence about 2 mm. from the anterior edge of the body, and extend to within 2 mm. of each other behind. The *mantle margin* extends far over the head dorsally, and the *siphon* is short. The *head* is rather narrow. The *arms* are about half the length of the body, their order being 4, 3, 2, 1. The *suckers* are in four series and of medium size; the *horny rings* have fallen out. No *hectocotylus* is present. The *umbrella* extends about one-fifth up the arms; the buccal membrane has the usual arrangement; the *outer lip* is thin, the *inner* thick and papillate. The *tentacles* are about twice the length of the body; the *club* flat and expanded, and the *suckers* apparently in four series. The *surface* is smooth. The *colour* is dark brown. The *shell* resembles that of *Sepia singaporensis*, Pfeffer, more nearly than any other known to me; the only differences being that the incurving of the margins of the loculi in the striated area is a little more pronounced, and there is a ridge or keel on the ventral surface of the spine (as in *Sepia cultrata*) not recorded by Dr. Pfeffer. These two species are much alike, but they differ in the arrangement of the suckers on the tentacular club.

Sepia esculenta, Hoyle (Pl. XVII. figs. 1–5; Pl. XVIII. figs. 1–6).

1885. *Sepia esculenta*, Hoyle, Diagnoses II., p. 188.
1885. ,, ,, Hoyle, Prelim. Rep. II., p. 291.
1886. ,, ,, Appellöf, Japanska Ceph., p. 28, pl. iii. figs. 1–6, 24.

Habitat.—Japan, purchased in the market, Yokohama. Two specimens, ♂, ♀. Japan (Appellöf).

The Body is broad, stout, and semielliptical posteriorly. The *fins* are about one-fourth of the body in breadth and commence within 6 mm. of the anterior margin, and end within 5 mm. of each other; the *mantle margin* is produced far over the head dorsally, and evenly truncated below. The *siphon* just reaches the gap between the ventral arms.

The Head is broad, and the *eyes* laterally prominent.

The Arms are subequal, the order of length being 4, 1, 2, 3, and nearly half as long as the body; they are all more or less compressed, especially the ventral ones; they have a distinct web along the outer margin, and a rather broad membrane runs up either side of the sucker-bearing face. The *suckers* are in four series throughout (Pl. XVII. fig. 2), not very obliquely set; they are large and spheroidal, and have meridional markings on the outer surface; the *horny ring* is smooth and surrounded by a narrow papillary area. In the *hectocotylised* arm of the male (Pl. XVIII. fig. 6) the first four rows of suckers are normal, then come two rows of gradually diminishing suckers, succeeded by four rows of minute ones, after which they again regain their normal dimensions. The *umbrella* is narrow, widest between the second and third arms, where it reaches up to the fifth row of suckers. The *buccal membrane* has the usual seven points in the male; in the female the two ventral ones are rounded off; the *spermatic pad* is exceedingly well developed, and has four deep transverse grooves. The *outer lip* is thin and longitudinally corrugated; the *inner* is thick and bears numerous very long papillæ.

The Tentacles are "about as long as or somewhat longer than the body; their *suckers* are small and of equal size, stand in about ten series and are somewhat oblique. The *horny rings* are provided on the distal margin with from twelve to fourteen very long but blunt teeth, which, on the proximal margin pass over into similar shorter ones."[1]

The Surface is smooth throughout.

The Colour is dull grey, mottled with black above, yellowish below.

The Jaws are shown on Pl. XVII. figs. 4, 5.

The Shell (Pl. XVII. fig. 3; Pl. XVIII. figs. 1, 2, 3) is elliptical in *outline*, somewhat broader behind (especially in the female); the *chitinous margin* is narrow and does not form a complete ridge across the shell below the spine; it forms two slightly expanded wings behind, and its uncovered marginal part is narrow; the *dorsal surface* is marked

[1] Appellöf, *loc. cit.* The tentacles had been removed from both the Challenger specimens.

with coarse rugosities disposed in curved lines parallel to the anterior margin; a distinct but low rib runs down the centre. The *ventral surface* is elevated on either side of a deep median groove; the *last loculus* has an index of 22 in the male and 17 in the female specimen, and is bounded posteriorly by two slightly wavy lines, meeting at an acute angle; the *striated area* is long, and the angle between the striæ widens posteriorly. The *inner cone* is very well developed; the *limbs* arise one-fifth the length of the shell from the posterior end, and gradually become more elevated until they enclose a deep conical cavity. The *spine* is strong and pointed (Pl. XVIII. figs. 1, 2), somewhat curved laterally in the female example.

Dimensions.[1]

Length, total,	240 mm.
End of body to mantle-margin, dorsally,	160 „
End of body to mantle-margin, ventrally,	140 „
End of body to eye,	155 „
Breadth of body,	75 „
Breadth of head,	55 „
Eye to edge of umbrella,	40 „
Breadth of fin,	20 „
Diameter of largest sucker on sessile arm,	2·5 „
Length of shell,	163 „
Breadth of shell,	52 „

	Right.	Left.
Length of first arm,	65 mm.	68 mm.
Length of second arm,	65 „	60 „
Length of third arm,	63 „	58 „
Length of fourth arm,	70 „	63 „

This fine species approaches *Sepia aculeata*, van Hasselt, but lacks the suckers on the buccal membrane,[2] and also the callosity of the inner cone at the posterior extremity of the shell. This cannot be due to immaturity, for the two specimens in the Challenger collection are larger than undoubted specimens of *Sepia aculeata*, in which this peculiarity is well marked.

It has moreover some resemblance to *Sepia brevimana*, Steenstrup, but the shell is not so broad in proportion nor so regularly elliptical, being rather more dilated in its posterior half.

Perhaps, however, its closest relationship is with an unpublished form in the Copenhagen Museum, labelled "*Sepiæ rostratæ affinis*," but that the posterior extremity of its shell is more rounded (both being females). The thickened spermatic pad is more fully developed in the Challenger than in the Copenhagen specimen, which may,

[1] The dimensions above are from the male specimen; in the female the length of the body is 143 mm. dorsally and 123 mm. ventrally and the breadth 70 mm., length of shell 143 mm., breadth 54 mm.

[2] Steenstrup, Hemisepius, pl. ii. fig. 4.

however, be owing to the smaller size and presumably less complete development of the latter, which had unfortunately lost the horny rings of its suckers, so that comparison of these parts was impossible.

The two specimens of the present species furnish an admirable illustration of the sexual differences in the genus *Sepia;* the structure of the hectocotylised arm has been described above, but in addition to that it is seen that the proportions of the body are very different; the breadth being 52 per cent. of the length in the male and 57 per cent. in the female. This difference is still more pronounced in the shells, the breadth of the male shell being only 32 per cent. of the length, while in the female it is 37 per cent.

Appellöf has had the good fortune to examine specimens of this species in which the tentacles were present, and I have inserted above a translation of his description of those organs. He adds also some interesting and valuable remarks on the gradual development of teeth in the suckers and on the relations of the species.

Sepia elliptica,[1] Hoyle (Pl. XIX. figs. 14–24).

1885. *Sepia elliptica*, Hoyle, Diagnoses II., p. 189.
1885. „ „ Hoyle, Prelim. Rep. II., p. 293.

Habitat.—Station 188, Arafura Sea, south of Papua, September 10, 1874; lat. 9° 59′ S., long. 139° 42′ E.; 28 fathoms; green mud. Four specimens, one ♂, three ♀.

Station 190, Arafura Sea, south of Papua, September 12, 1874; lat. 8° 56′ S., long. 136° 5′ E.; 49 fathoms; green mud. Four specimens, one ♂, three ♀.

The Body is ovoid, broadest one-third from the anterior margin, pointed behind. The *fins* are one-third the width of the body, broadest in the middle, extending the whole length of the body, and approaching within 2 mm. of each other posteriorly. The *mantle-margin* is not very prominent over the head dorsally. The *mantle-connective* is rather short and deep, but otherwise normal. The *siphon* is conical, reaching to within 1 mm. of, or quite up to the space between the ventral arms.

The Head is very short and broad, the *eyes* prominent.

The Arms are subequal, the order of length being 4, 3, 2, 1, or 4, 2, 3, 1; they are nearly half the length of the body, and taper evenly to fine points; there is a distinct but narrow ridge along the fourth arm, and a delicate web along each side of the oral aspect of the arms. The *suckers* are in four series throughout, and of moderate size, marked with inconstant meridional grooves (fig. 17), and there is a large notch proximally and distally in the rim (fig. 19). The *horny ring* has for the most part no distinct teeth, but is marked in the distal half with shallow irregular notches, which are occasionally more regular (figs. 17, 19). A papillary area surrounds the horny ring (fig. 18). The *hectocotylus* is developed in about the middle third of the left ventral arm (fig. 16); beyond

[1] So named from the form of the shell.

the eighth row of suckers the two ventral series are continued of the normal size, but the two dorsal are each represented by five minute suckers, gradually diminishing to the middle one and then increasing again; beyond this the arm exhibits no peculiarities. The *umbrella* is widest between the two lateral arms, where it extends as far as the sixth row of suckers. The *buccal membrane* bears the usual seven distinct points in the male, whilst in the female the ventral pair are lost in the thick swollen *spermatic pad* (fig. 15), which is subdivided by four or five deep grooves into as many transverse ridges. The *outer lip* is thin; the *inner* bears about half a dozen rows of distinct hemispheroidal papillæ.

The Tentacles are about as long as the mantle; the *stem* is indistinctly three-sided; the *club* is long and wide, and bears eight series of minute equal suckers; there is a *protective membrane* on either side and a broad *fin* on the dorso-internal aspect. The *horny ring* is small and has a smooth margin.

The Surface is smooth.

The Colour is a dull grey dorsally, pale yellowish below.

The Jaws are shown in figs. 20, 21.

The Shell (figs. 22–24) is broad, subelliptical in *outline*, the anterior extremity bounded by two straight lines, which form obtuse rounded-off angles with each other and the sides of the shell; the posterior is rounded gradually off. The *dorsal surface* has a faint ridge passing to each of the three angles just mentioned, and is covered with curved rows of tubercles parallel to the anterior margin. The *ventral surface* is but little elevated; the *last loculus* has an index of 34, and is bounded behind by a broadly open curve with three or four irregular sinuations in it. The *striated area* is hollowed posteriorly and is marked by grooves corresponding to the sinuations just mentioned. The *inner cone* arises about halfway along the striated area, curves evenly outwards, and then rises into a distinct ridge, forming a wall separate from the margin of the shell; its ventral surface is marked by a number of striæ pointing in the direction of the *spine*, which is of medium length and strength, and curved gently upwards.

Dimensions.[1]

Length, total,	102 mm.
End of body to mantle-margin,	72 „
End of body to eye,	66 „
Breadth of body,	40 „
Breadth of head,	33 „
Eye to edge of umbrella,	15 „
Breadth of fin,	11 „
Diameter of largest sucker on sessile arm,	1 „
Length of shell,	72 „
Breadth of shell,	31 „

[1] Taken from one of the female specimens from Station 188.

	Right.	Left.
Length of first arm,[1]	25 mm.	25 mm.
Length of second arm, ...	27 „	27 „
Length of third arm, ...	26 „	26 „
Length of fourth arm, ...	27 „	30 „
Length of tentacle, ...	...	72 „
Length of tentacular club, ...	...	12 „

The shell of this species resembles that of *Sepia brevimana*, Steenstrup, but it is not so hollow, and has a series of two or three radial ridges on the middle of the inferior surface of the inner cone (fig. 24), while in the latter species the inner cone has a thickened margin not seen in these specimens. It also resembles that of *Sepia aculeata*, but the inner cone is very much less pronounced, and as regards the animal itself, the tentacular club is much shorter and there are no suckers on the buccal membrane.

In general form the shell bears some likeness to *Sepia rostrata*, but the inner cone is much less developed and the spine very much smaller, while the horny ring of the suckers is not "*très petit*" nor has it "bords lisses" as stated by d'Orbigny, though here his description does not agree with his figure.[2]

The specimens from Station 190 differ a little from those from Station 188 in that the horny rings of the suckers of the sessile arms are more decidedly toothed, but both forms agree so closely in other characters, that I have not thought it necessary to separate them formally. This fact is an instance of an observation that has frequently been made in regard to other classes of animals, namely, that in those regions where a genus is particularly abundant and rich in species, it presents also the largest number of varieties, whence the species show a greater tendency to run into each other and become more difficult to define. There seems abundant reason to believe, as will be shown in the section of this Report treating of Distribution, that the Indian Archipelago and neighbouring seas are the localities richest in species of *Sepia*.

Sepia cultrata, Steenstrup MS. (Pl. XX.).

... *Sepia cultrata*, Stp., MS. in Mus. Havn.
1885. „ „ Hoyle, Diagnoses II., p. 198.
1885. „ „ Hoyle, Prelim. Rep. II., p. 303.
var. = „ *capensis*, Gray, B. M. C., p. 110 (*excl. syn.*).

Habitat.—Station 163A, off Twofold Bay, Australia, April 4, 1874; lat. 36° 59′ S., long. 150° 20′ E; 150 fathoms; green mud. One specimen, ♀.

The Body is elongated, broadest about the middle of its length. The *fins* are rather narrow, about one-fourth the breadth of the body, commencing 2 mm. from the anterior edge of the body and approaching within 5 mm. of each other posteriorly; the

[1] Measured from the oral margin.

[2] Compare. Céph. acét., pl. xxvi. figs. 7, 8.

left is somewhat broader than the right. The *mantle-margin* extends far over the head dorsally and is not emarginate, but slightly undulating ventrally. The *siphon* is short, terminating far short of the depression between the ventral arms.

The Head is broad, and the *eyes* very prominent.

The Arms are subequal, the order of length being 4, 1, 2, 3; they are one-fourth the length of the body, all are flattened and taper evenly to fine points. The *suckers* are in four series (fig. 4), except in the right dorsal arm, where they appear to be in two, probably owing to its state of extreme compression; they are of medium size, many are deeply notched proximally and distally, and provided with fine meridional grooves on the margin (fig. 6); the *horny ring* is smooth and surrounded by a papillary area. The *hectocotylus* was not seen, the only specimen being a female. The *umbrella* is small, widest between the lateral arms, where it reaches up to the sixth or seventh row of suckers. The *buccal membrane* has five distinct points, the ventral edge being thickened and forming a large folded *spermatic pad* (fig. 3); it bears no suckers. The *outer lip* is thick, and marked with fine longitudinal grooves; the *inner* is papillate.

The Tentacles are as long as the mantle, with a three-sided flattened *stem*, much broader proximally than distally. The *club* is slightly expanded, with a narrow protective membrane below, a broad one above, and a distinct web outwardly (fig. 5). There are five or six series of *suckers*, slightly larger in the middle than at the margins, on very long slender peduncles; the *horny ring* is smooth.

The Surface bears a number of small irregularly scattered papillæ, and four or five elongated warts on the dorsum near the origin of the fins, and some folds in the skin on the ventral surface; probably these are due to contraction.

The Colour is a dull grey with a bluish shade above inclining to yellow below.

The Jaws are shown in figs. 7, 8.

The Shell (figs. 9–11) has an elongate oval *outline*, broadest one-third of the way back and rounded off at both ends. The free *chitinous margin* is narrow anteriorly, then broader, evanescent posteriorly, a deep calcareous *outer cone* forming the posterior extremity of the shell; it is but slightly exposed on the *dorsal surface*, which bears only faint indications of a median ridge, and is beset with fine granules disposed in rows parallel to the anterior margin. The *ventral surface* is elevated so as to give the shell a more than average thickness; the *last loculus* has an index of 33, and is bounded by a tranverse hemielliptical curve; the *striated area* is excavated, but slightly convex in the middle line. The *inner cone* consists only of the slightly elevated limbs, which run along three-quarters of the striated area and unite with each other as a flattened fillet posteriorly. The *spine* has lost its extreme point, but it is strong, and has a raised knife-like ridge developed upon its ventral aspect[1] (fig. 11).

[1] Whence the specific name.

Dimensions.

Length, total,	113 mm.
End of body to mantle-margin,	84 „
End of body to eye,	78 „
Breadth of body,	37 „
Breadth of head,	40 „
Eye to edge of umbrella,	18 „
Breadth of fin,	8 „
Diameter of largest sucker on sessile arm,	1 „
Diameter of largest sucker on tentacle,	0·6 „
Length of shell,	90 „
Breadth of shell,	29 „

	Right.	Left.
Length of first arm,[1]	23 mm.	22 mm.
Length of second arm,	22 „	20 „
Length of third arm,	20 „	20 „
Length of fourth arm,	23 „	22 „
Length of tentacle,	80 „	...

This species is of special interest because it has hitherto been known only from a shell in the Zoological Museum at Copenhagen, which was the only specimen then known to possess the peculiar ridged spine shown in fig. 11. Recently, however, I

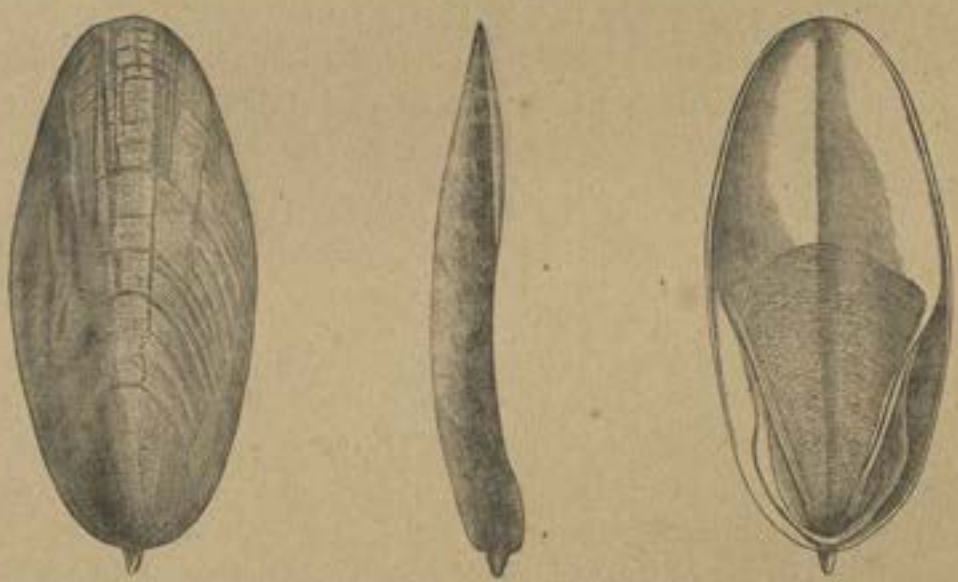

FIG. 5.—Shell of *Sepia mestus*, Gray, from the type specimen in the British Museum labelled "Sep. mestus, Australia, Presented by Dr. Sinclair, R.N." Drawn by Mr. P. J. Smit.

happened to notice that the type of Gray's *Sepia mestus* was similarly armed, but being then unable to make a thorough investigation of the matter, I sent the Challenger specimen to my friend Mr. Edgar Smith who was good enough to institute a comparison

[1] The lengths of the arms are measured from the oral margin.

for me between the two shells; he says (as is obvious from the figures), that the Challenger species is different in form from *Sepia mestus*, which is comparatively broader "and has a peculiar raised band on each side not unlike a muscular scar"; and adds "I think your shell may be the same species (although a *var.*) that Gray has identified in the museum collection as *Sepia capensis*, but which seems to me distinct from *Sepia capensis* of d'Orbigny (=*Sepia australis*, Gray and Gaimard). Our two shells, both from Australia (one from Port Jackson), are rather narrower than yours;" further, the last loculus is smaller and the curve of its posterior margin is more flattened. The two shells alluded to by Mr. Smith are here figured for comparison with the Challenger specimen.

The present specimen differs from *Sepia capensis*, d'Orbigny, in the form of the

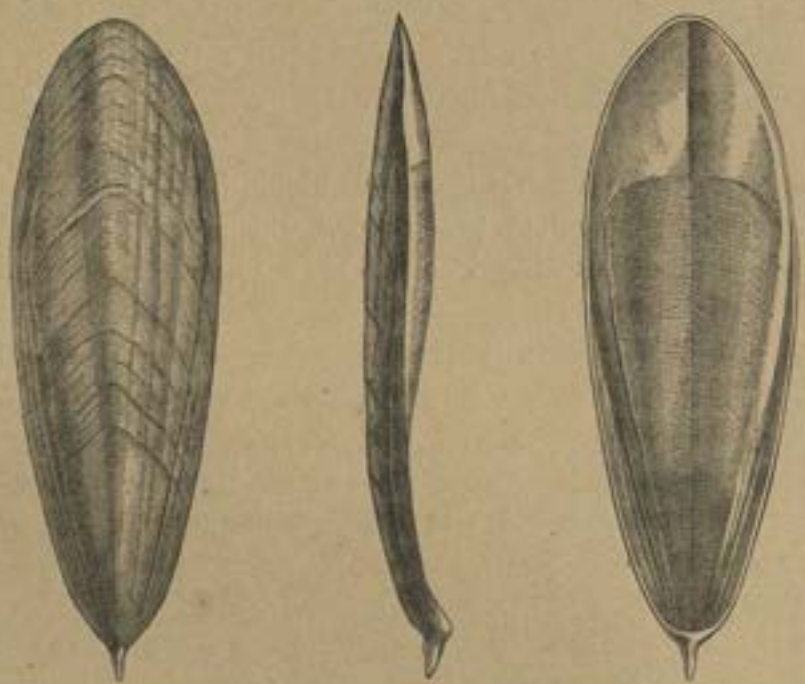

Fig. 6.—Shell of a *Sepia* in the British Museum labelled "*S. capensis*. Sydney, Presented by J. Edwards, Esq. R.N." Drawn by Mr. P. J. Smit.

ventral aspect of the shell; furthermore, the curves of the striated area are more transverse, the anterior extremity is more pointed, and there is the ridge on the spine not mentioned by d'Orbigny (compare Céph. acét., pl. vii. fig. 4). As regards the external characters of the animal, *Sepia capensis* has three suckers on the tentacle larger than the rest, and on the sessile arms the two inner series of suckers are larger than the outer.

The second left arm shows an abnormality, the groove in which the suckers lie being interrupted for about 2 mm. by the folding over and union of the two margins; the part of the arm beyond this has only two series of very small suckers (fig. 2).

Sepia recurvirostra (*?*), Steenstrup.

1875. *Sepia recurvirostra*, Steenstrup, Hemisepius, pp. 475, 479.

Habitat.—Station 207, off Tablas Island, January 16, 1875; lat. 12° 21′ N., long. 122° 15′ E.; 700 fathoms. One broken shell.

Eastern Archipelago (Copenhagen Museum).

A much mutilated shell was brought up in the trawl at the above locality; unfortunately the posterior extremity, which furnishes the most striking character of Professor Steenstrup's species, was wanting, but still the general form of the body of the shell and the curvature of the lines in the striated area resemble that type more than any other known to me, and as the locality is corroborative of this view I refer it with a query to that species.

Sepia sulcata,[1] Hoyle (Pl. XIX. figs. 1–13).

1885. *Sepia sulcata*, Hoyle, Diagnoses II., p. 192.
1885. „ „ Hoyle, Prelim. Rep. II., p. 296.

Habitat.—Station 192, off the Ki Islands, Arafura Sea, September 26, 1874; lat. 5° 49′ 15″ S., long. 132° 14′ 15″ E.; 140 fathoms; blue mud. One specimen, ♂.

The Body is cylindrical in its anterior fourth, then tapers gradually backwards, and is pointed behind. The *fins* are one-fifth the breadth of the body, commence 2 mm. from the anterior margin of the mantle, and approach within 5 mm. of each other posteriorly; the *mantle-margin* reaches far over the head dorsally, and is evenly truncated below. The *siphon* does not extend up to the interbrachial space.

The Head is broad and the *eyes* very prominent; in the only specimen it is much retracted into the mantle.

The Arms are subequal, the order of length being 4, 3, 2, 1; they are one-third the length of the mantle, and taper gradually to slender points; the first are thin and rounded, the fourth flattened, each has a distinct ridge on the outer side, which in the fourth expands to a broad membrane. The *suckers* are in two series in the first and second arms, but with a tendency to form four series in the others, more especially in the distal portions; they are pedunculate and very oblique (fig. 7), and the margin is marked with meridional grooves and has a deep distal notch; the *horny ring* is small, smooth, and surrounded by a papillate area (fig. 8). The left ventral arm is *hectocotylised* (figs. 4, 5); along three-fourths of its length runs a groove with convex bottom, bounded on either side by a narrow fillet; on either margin of the groove is a row of minute suckers, which are larger and more distinct, and even form two series on

[1] So named from the form of the hectocotylised arm.

the ventral aspect; the tip of the arm bears two series of small suckers. The *umbrella* is better developed than usual, its greatest extent (between the lateral arms) being up to the eighth rows of suckers. The *buccal membrane* has the usual seven points, but not very strongly marked; the *outer lip* is smooth and thin, the *inner* papillate.

The Tentacle is as long as the head and body together, with a slender and somewhat flattened stem; the *club* (fig. 3) is short and rather broad, and has a protective membrane on either side of the suckers, and a broad web on the dorsal aspect, extending for a distance equal to half its length down the stem; there are from six to eight rows of very minute *suckers*, subequal, and with smooth *horny rings*.

The Surface is smooth, except that on one side of the ventral surface are three slightly raised linear ridges, apparently due to contraction, and a few minute papillæ on the dorsal surface posteriorly.

The Colour is on the whole pale, yellowish below, purplish above.

The Jaws are shown in figs. 9, 10.

The Shell (figs. 11–13) is hemielliptical in *outline* anteriorly, tapering to a point behind. The *chitinous margin* is rather broad, widest about two-thirds back; it is bare over all except the median third of the *dorsal surface*, which is finely rugose, and has a slightly elevated median portion and a faint linear ridge in the middle line posteriorly, about 3 mm. long, and terminating 2 mm. from the base of the spine. The *ventral surface* is but little elevated; the *last loculus* occupies more than one-third of it, and its posterior boundary is almost semicircular, inflected in the centre. The *inner cone* is evanescent; its limbs are chitinous and form a ventral margin to the terminal cone. A *spine* is present, but, as it had been broken off, its length and form cannot be determined.

Dimensions.

Length, total,	112 mm.
End of body to mantle-margin,	45 „
End of body to eye,	49 „
Breadth of body,	25 „
Breadth of head,	22 „
Eye to edge of umbrella,	12 „
Breadth of fin,	5 „
Diameter of largest sucker on sessile arm,	0·5 „
Diameter of largest sucker on tentacle,	0·16 „
Length of shell,	52 „
Breadth of shell,	21 „

	Right.	Left.
Length of first arm,	22 mm.	22 mm.
Length of second arm,	23 „	23 „
Length of third arm,	24 „	24 „
Length of fourth arm,	26 „	25 „
Length of tentacle,	65 „	63 „

The shell of this species is peculiar in having a spine as well as, near to but distinct from it, a keel, upon the dorsal aspect of the shell. *Sepia elegans*, d'Orb., has the keel but no spine, while an unnamed specimen from the Cape in the Copenhagen Museum has a stronger keel reaching quite up to the spine, which is larger and thinner than in this specimen.

The tentacular club is like that of *Sepia brevimana*, Steenstrup.

The integument in the middle of the back has been pierced down to the shell by a neat round hole, presumably the work of some parasite (see fig. 2).

Sepia andreanoides, Hoyle (Pl. XXI. figs. 11–19; Pl. XXII. fig. 11).

1885. *Sepia andreanoides*, Hoyle, Diagnoses II., p. 193.
1885. „ „ Hoyle, Prelim. Rep. II., p. 297.

Habitat.—Japan. Purchased in the market, Yokohama. Three specimens, one ♂, two ♀.

The Body is very long, broadest one-third of the way back, pointed and acuminate behind. The fins are narrow, they commence 3 mm. behind the anterior margin, and terminate 5 mm. from the posterior end of the body, and, approaching within 3 mm. of each other, extend a little distance upon the dorsal aspect of the body. The *mantle-margin* extends well over the head dorsally, and is very slightly emarginate ventrally. The *siphon* extends about as far forward as the middle of the eyes, but not up to the space between the ventral arms.

The Head is decidedly narrower than the body and somewhat elongated; the *eyes* being distended and laterally prominent.

The Arms are subequal, the order of length being 1, 2, 3, 4, or 1, 4, 3, 2; they are two-fifths the length of the body, elongated, conical (except the fourth pair, which are flattened), and taper to very slender tips. The *suckers* seem to be normally in four series, but in some cases the arms are so compressed that they appear to be in only two, especially at the proximal extremities of the first and second arms; they are globular, slightly oblique, with a small aperture and smooth *horny ring* (fig. 17). The distal half of the left ventral arm of the male is *hectocotylised* (Pl. XXII. fig. 11); the suckers are normal up to the twelfth row, after which the arm widens and has a median groove from which about twelve shallow grooves pass outwards on either side, separating raised portions, each of which bears a minute sucker on the dorsal side of the groove. The *umbrella* is present only between the second and third and third and fourth arms up to the fourth row of suckers. The *buccal membrane* is well developed and has the usual seven points; in the female there is a deeply grooved *spermatic pad*. The *outer lip* is thin and smooth, the *inner* thick and papillate.

The Tentacles are somewhat longer than the head and body, very slender and some

what flattened. The *club* (Pl. XXI. fig. 13) is flattened and expanded; along its outer margin is a very narrow membrane, and along the median edge, at some distance from the cupules, is a broad web, marked on the dorsal aspect with fine parallel shallow oblique grooves; along one margin it bears three or four series of small pedunculate *suckers*, whose *horny rings* bear very numerous and acute teeth.

The Surface is smooth.

The Colour is a dull purplish grey above, ochre with purple chromatophores below.

The Jaws are shown in figs. 18, 19.

The Shell (figs. 14–16) has a narrow elongated oval *outline*, somewhat pointed in front and tapering gradually backwards; the *chitinous margin* is uncovered over about one-third of the *dorsal surface*, which shows the boundary lines of the loculi clearly as brown striæ, and is very minutely roughened; the *ventral surface* is elevated, so that the shell is thick in proportion to its breadth, a narrow groove runs down the centre; the *last loculus* has an index of 28·3 in the male and 30·5 in the female, and is bounded posteriorly by a shallow open curve. The *posterior extremity* is a very flattened irregular cone, to the apex of which the spine is attached; the *inner cone* is very shallow and its opening is some 4 mm. distant from the margin of the outer cone. The *spine* is long, straight, and points directly backward.

Dimensions.[1]

Length, total,	177 mm.
End of body to mantle-margin,	60 „
End of body to eye,	62 „
Breadth of body,	27 „
Breadth of head,	19·5 „
Eye to edge of umbrella,	9 „
Breadth of fin,	3 „
Diameter of largest sucker on sessile arm,	0·6 „
Diameter of largest sucker on tentacle,	0·25 „
Length of the shell,	60 „
Breadth of the shell,	12·5 „

	Right.	Left.
Length of first arm,[2]	35 mm.	25 mm.
Length of second arm,	31 „	25 „
Length of third arm,	28 „	28 „
Length of fourth arm,	28 „	27 „
Length of tentacle,	90 „	115 „

This species resembles *Sepia andreana*, Steenstrup, from Hako Dadi, Japan, very closely in the form of the shell, which, however, is here a little thicker and broader in proportion to its length; in both, too, the ventral and third-arms have a strong keel; the suckers are in four series except a varying number (two to four rows) at the

[1] Of the male specimen. In one of the females the shell is 59 mm. long and 13 mm. broad.

[2] The lengths of the arms are measured from the eye.

beginning of the arms; the suckers are small and globular and the highest power of a hand-lens shows no teeth on their horny rings.

Sepia andreana is distinguished by the extraordinary development of the second arms, which are nearly twice as long as the others, and by the greater shortness of the tentacular club, which bears a single median row of five suckers larger than the others. The suckers on the tips of the longest sessile arms are in two series.

In one specimen the tentacles were completely exserted, in another partially, in the third completely retracted, in which condition they could be distinctly traced through the integuments on the under surface of the head disposed in close windings (Pl. XXI. fig. 11).

Sepia kiensis, Hoyle (Pl. XVII. figs. 6–11).

1885. *Sepia kiensis*, Hoyle, Diagnoses II., p. 194.
1885. „ „ Hoyle, Prelim. Rep. II., p. 299.

Habitat.—Station 192, off the Ki Islands, Arafura Sea, September 26, 1874; lat. 5° 49′ 15″ S., long. 132° 14′ 15″ E.; 140 fathoms; blue mud. One specimen, ♀.

The Body is narrow, widest anteriorly, and tapering gradually backwards; the *fin* is narrow, less than one-quarter the breadth of the body, widening a little behind; it commences 1 mm. from the anterior margin and extends to within 2 mm. of its fellow behind. The *mantle-margin* is prominent dorsally and slightly emarginate ventrally. The *siphon* does not quite extend to the bases of the arms.

The Head is broad, and the *eyes* rounded and prominent.

The Arms are subequal, the order of length being 4, 3, 2; 1; they are very short, about one-third the length of the body; the first and second are conical, the third flatter, with a slight ridge externally, and the fourth broad and flat with a distinct crest. The *suckers* are in four series throughout, small, spheroidal, and not very oblique; the *horny ring* is smooth. The specimen being a female no *hectocotylus* is developed. The *umbrella* is evanescent, extending at most only up to the second row of suckers; the *buccal membrane* has five points and is rounded dorsally; the *spermatic pad* is but slightly developed. The *outer lip* is thin and grooved longitudinally, the *inner* thicker and papillate.

The Tentacles are as long as the head and body; the *stem* being slender and indistinctly three-sided. The *club* (fig. 8) is very slightly expanded; a protective membrane, grooved obliquely on the dorsal aspect, is situated on the outer margin, and there is a web on the internal side. The *suckers* are in four or five series, which are slightly larger towards the inner margin; the *horny ring* presents a few acute teeth.

The Surface is smooth throughout.

The Colour is a dull reddish grey above, yellowish below.

The Shell (figs. 9-11) is very elongate oval in *outline*; the free *chitinous margin* is very narrow and only slightly uncovered on the *dorsal surface*, which is finely granular and marked by the divisions between the loculi; the *ventral surface* is somewhat elevated and marked by a distinct but not very deep median groove; the *last loculus* has an index of 40·5, and is bounded posteriorly by an almost semicircular line; the *striæ* are very close; the limbs of the *inner cone* arise about midway along the shell, pass backwards as low, narrow, smooth fillets, and unite behind without forming any deep cavity; the *posterior extremity* is curved towards the ventral aspect and ends in a narrow blunt *outer cone*, to the apex of which is attached the straight dorsally directed spine.

Dimensions.

Length, total,	82 mm.
End of body to mantle-margin,	37 „
End of body to eye,	34 „
Breadth of body,	18 „
Breadth of head,	15 „
Eye to edge of umbrella,	4 „
Breadth of fin,	3 „
Length of the shell,	37 „
Breadth of the shell,	11 „

	Right.	Left.
Length of first arm,[1]	8 mm.	9 mm.
Length of second arm,	9 „	9 „
Length of third arm,	10 „	10 „
Length of fourth arm,	10 „	10 „
Length of tentacle,	...	45 „

The posterior extremity of the shell of this form closely resembles that of *Sepia andreana*, Steenstrup, from Japan, but both animal and shell are much wider as well as thicker in proportion to the length. Furthermore, the arms are subequal, whereas in Steenstrup's type those of the second pair are nearly twice as long as the others. In the Challenger specimen also the tentacular club is long, narrow, and provided with subequal suckers, while in *Sepia andreana* it is shorter and there are five larger suckers along its middle.

Sepia kobiensis, Hoyle (Pl. XVIII. figs. 7–14; and woodcut 7).

1885. *Sepia kobiensis*, Hoyle, Diagnoses II., p. 195.
1885. „ „ Hoyle, Prelim. Rep. II., p. 300.
1886. „ „ Appellöf, Japanska Ceph., p. 20, pl. iii. fig. 7.

Habitat.—Station 233, Bay of Kobé, Japan, May 17, 1875; lat. 34° 39′ N., long. 135° 14′ E.; 8 fathoms; mud. One specimen, ♀.

[1] Measured from the oral margin.

The Body is long and narrow, widest near the anterior margin, and tapers gradually backwards. The *fin* is very narrow, only one-eighth the breadth of the body; it commences 3 mm. from the margin of the body, and posteriorly passes on to the ventral surface, and terminates 2 mm. from its fellow and 4 mm. from the extremity of the body. The *mantle-margin* has a narrow projection over the head, and is evenly truncated ventrally. The *siphon* is short, reaching barely halfway to the space between the ventral arms.

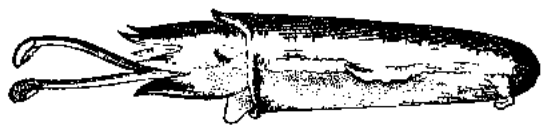

Fig. 7.—*Sepia kobiensis*; side view, showing how the fins terminate on the ventral surface of the body.

The Head is of medium breadth, and the *eyes* prominent laterally.

The Arms are subequal, the order of length being 2, 4, 1, 3(?), and less than one-third the length of the body; the first two pairs are subconical and slender, the third broader and with a web running up the ventral aspect, the fourth wider and with a distinct ridge along the outer edge; they all taper to very fine points. Many of the *suckers* are deficient, but they seem to have stood in four series throughout; they are spheroidal (fig. 11) and very oblique, the distal margin of many has a deep notch (fig. 10); the *horny ring* is smooth in most cases, but occasionally possesses a few angular teeth. The specimen being a female no *hectocotylus* is present. The *umbrella* is but little developed, its greatest extent being between the ventro-lateral arms, where it reaches the fourth row of suckers. The *buccal membrane* has the usual seven points, the two ventral being the least distinct (as usual in female specimens); the *spermatic pad* is small. The *outer lip* is narrow, the *inner* thick and papillate.

The Tentacles are shorter than the body and slender; the *stem* has three sides, the inner being slightly hollow, with a slender fillet along the middle. The *club* (fig. 9) is slightly expanded with a distinct protective membrane; the inner side of the club is deeply grooved, and internally to the groove is a rather broad fin. The *suckers* are in about five series, near the inner margin are three rather larger than the rest,[1] which gradually diminish towards the outer margin. The *horny rings* of the larger suckers have about twenty fine teeth on the distal semicircumference, the smaller have fewer in proportion.

The Surface is smooth all over.

The Colour is a dark purplish grey above, paler below.

The Shell (figs. 12–14) is a very elongated oval in outline; the *chitinous margin* is very narrow and is uncovered over one-third of the *dorsal surface*, which is smooth and evenly convex, with the exception of a slight ridge along the middle line; the *ventral*

[1] Not adequately shown in the figure.

surface is elevated, so that the shell is thick, with a shallow median groove becoming evanescent posteriorly, the *last loculus* has an index of 36·6 and is bounded by a slightly curved line with a cusp where the median groove meets it; the *inner cone* is formed by two limbs, which arise halfway along the shell and form a rounded fillet slightly more elevated posteriorly, where they bound a shallow depression; outside them the margin of the shell expands into a subcircular plate (the *outer cone*), from the centre of which the *spine* projects backwards; no information can be given as to its form or length, as it has been broken off close to the base.

Dimensions.

Length, total,	72 mm.
End of body to mantle-margin,	42 „
End of body to eye,	41 „
Breadth of body,	16 „
Breadth of head,	14 „
Eye to edge of umbrella,	6 „
Breadth of fin,	2 „
Length of shell (without spine),	41 „
Breadth of shell,	7 „

	Right.	Left.
Length of first arm,	10 mm.	10·5 mm.
Length of second arm,	11 „	10 „
Length of third arm,	9·5 „	9 „
Length of fourth arm,	9 „[1]	10·5 „
Length of tentacle,	25 „	...

This is nearly related to *Sepia kiensis*, but is longer and narrower in its proportions, notwithstanding that both specimens are females, and this difference is still more marked in the shell; in that species its breadth is about two-fifths of the length, while in the present form it is less than one-fifth; in the former case the locular index is 40·5, in the latter 36·6. The type specimens of both species are probably immature, and their validity can only be regarded as of a provisional nature.

Since the above description was drawn up I have been able to see Appellöf's description of the specimens of this form which he received from Japan; his account of them agrees so well with the type specimen that there can be little doubt that they are correctly referred to the same species. I notice a few differences, however, which it seems advisable to record. The arms are considerably larger, proportionately, than in the Challenger specimen, in which furthermore the diversity in the sizes of the suckers on the sessile arms is scarcely apparent. As stated above, many of these were absent, but a renewed investigation has led me to think that Appellöf's account of their arrangement is probably correct, though, like him, I regarded their disposition in two rows as merely

[1] Mutilated.

apparent, and consequently described them as "seeming" to be in four series. The shell of the Challenger specimen is decidedly narrower than the one figured by Appellöf, and the raised median tract appears to be by no means so prominent.

Metasepia, subgen. nov.

Body short, rounded, thick dorso-ventrally; *nuchal cartilage* without linear groove and *mantle* devoid of corresponding ridge; *siphono-pallial* articulation deep.

Tentacular club with unequal suckers.

Shell rhomboidal in outline, with no calcareous covering on the dorsal surface of the chitinous sheet; no *spine*.

Sepia (*Metasepia*) *pfefferi*,[1] Hoyle (Pl. XXI. figs. 1–10).

1885. *Sepia* (*Metasepia*) *Pfefferi*, Hoyle, Diagnoses II., p. 199.
1885. „ „ „ Hoyle, Prelim. Rep. II., p. 304.

Habitat.—Station 188, south of Papua, in the Arafura Sea, September 10, 1874; lat. 9° 59′ S., long. 139° 42′ E.; 28 fathoms; green mud. One specimen, ♀.

The Body is short and stout, broadest about the middle of its length, very thick (dorso-ventrally), and bluntly rounded behind. The *fins* are one-fourth as broad as the body and placed much nearer the dorsal than the ventral surface; they commence 2 to 3 mm. from the anterior margin and are connected by a narrow fillet behind; a slightly raised ridge passes down the ventro-lateral aspect of the body. The *mantle-margin* projects very slightly dorsally and is a trifle emarginate opposite the funnel; the *nuchal cartilage* has no distinct linear groove as in most species, but only a slight depression, while the corresponding part of the mantle has a triangular eminence about half as broad as long, and with the rounded apex directed forwards; the *connective cartilages* are deeper than in most species of *Sepia*, but there is no distinct knob as in *Sepiella*, their greatest depth being in the middle not anteriorly; there is no posterior gland. The *siphon* reaches up to the depression between the ventral arms.

The Head is broad, and the *eyes* prominent.

The Arms are subequal, in order of length 3, 4, 2, 1, or 4, 3, 2, 1; they are rather more than half as long as the body and distinctly three-sided, having a ridge on the outer side of each, broadest on the ventral ones; they taper evenly to very fine points; the inner surface of each is roughly papillate, and has hemispherical depressions into which the suckers are retracted. The *suckers* are in four series throughout, almost hemispherical, not very oblique, and marked with meridional grooves; the *horny ring* bears irregular square teeth. The *hectocotylus* is not developed, the specimen being a

[1] Named after my friend Dr. Georg Pfeffer of the Hamburg Museum, who has recently published a valuable catalogue of the Cephalopoda of that institution.

female.[1] The *umbrella* is larger than usual in the genus, reaching on an average about one-third up the arms; the *buccal membrane* has seven not very prominent points, and there is a *spermatic pad* as usual (fig. 3); the *outer lip* is very thin, the *inner* thick and papillate.

The Tentacle is about as long as the body, stout, indistinctly three-sided, and tapering. The *club* (fig. 7) is short and but little expanded, with a narrow protective membrane on its outer side; the sucker-bearing area is, as it were, undermined on its inner aspect by a deep groove or fissure, and internally to this again is a broad fin which reaches down the tentacle for a distance exceeding half the length of the club. There are three *suckers* much longer than the rest, whereof the middle one is the largest and the proximal the next, placed on stout peduncles arising in deep depressions; towards the outer side of the club is a series of about four medium-sized suckers, and beyond these again one or two series of minute ones. The *horny rings* appear smooth under a powerful hand-lens, though the microscope reveals a fine irregular denticulation.

The Surface is smooth in general, but there are a few irregular papillæ in the ventro-lateral region.

The Colour is a dull grey, with indications of annular markings on the back disposed in the form of a cross (fig. 1).

The Shell (figs. 4, 5) has a rhomboidal *outline*, with rounded anterior and lateral angles; the *chitinous margin* is narrow, widest behind, where it forms a flat, acute-angled plate, the posterior extremity of the shell; it covers entirely, however, the *dorsal surface*, which is slightly raised mesially and marked by a number of faint striæ radiating from the posterior end. The *ventral surface* is much elevated on either side of a median groove; the *last loculus* is bounded by a wavy line, and deeply emarginate in the middle; it has an index of 22. The *inner cone* is represented only by a narrow rib reaching halfway along each posterior side of the shell and meeting its fellow in a rounded angle behind, from which a number of radiating calcareous streaks pass outwards into the horny termination.

Dimensions.

Length, total,	110 mm.
End of body to mantle-margin,	52 „
End of body to eye,	60 „
Breadth of body (excluding fin),	32 „
Breadth of head,	32 „
Eye to edge of umbrella,	18 „
Breadth of fin,	8 „
Diameter of largest sucker on sessile arm,	1 „
Diameter of largest sucker on tentacle,	2 „
Length of shell,	45 „
Breadth of shell,	24 „
Thickness of shell,	8 „

[1] Appellöf records that he found no trace of the formation of the hectocotylus in the male examined by him.

	Right.	Left.
Length of first arm,	30 mm.	25 mm.
Length of second arm,	36 „	30 „
Length of third arm,	36 „	31 „
Length of fourth arm,	30 „	32 „
Length of tentacle,	52 „	67 „

This interesting species is represented in the collection by only one female specimen, but exhibits such peculiarities as to render it worthy of great attention.

The form of the body is remarkable for its great dorso-ventral extent, and for the ridge which runs down the ventro-lateral aspect. This is not very prominent, but is similar to the ridge observed in many species of *Octopus* and *Eledone* (*e.g.*, *Octopus australis*, p. 88 and Pl. III. fig. 5, and *Eledone cirrosa*), but I do not remember to have seen it before in any specimen of *Sepia*.

The tentacular club bears the greatest resemblance to that of *Sepia elegans*, d'Orbigny,[1] in respect of its shortness and rounded form, and in the presence of three suckers considerably exceeding the others in size. *Sepia tuberculata*, Quoy and Gaimard, has also three enlarged suckers, but judging by d'Orbigny's figure,[2] these would seem to be along the median line of the club and not nearer to one side than the other as in the present form. It may be remarked, however, that very few, if any, species of *Sepia* have the club so symmetrical as that figure would indicate, and hence the possibility of inaccuracy in this respect must be borne in mind. This is especially important because, as will be seen immediately, these two species present, in one respect, a close resemblance to each other.

The shell of the type under consideration is undoubtedly its most remarkable characteristic. In the first place it possesses no trace of a spine, a point in which it resembles *Sepia elegans*, d'Orbigny, above alluded to, and also the various species of *Sepiella*, which latter it further resembles in the depth of the siphono-pallial articulation; in all these, however, the chitinous layer of the shell is covered for the most part by a rough calcareous deposit, and only appears at the margin, and the genus *Sepiella* is clearly distinguished by its peculiar glandular apparatus.

The chitinous portion of the shell of *Sepia pfefferi* is visible over the whole of its dorsal surface, and this fact separates it clearly from all *Sepiæ* or related forms, with two exceptions, *Sepia tuberculata*, Lamarck,[3] and *Hemisepius typicus*, Steenstrup.[4] The former of these has an oval shell, the calcareous portion coming close up to the anterior margin, but narrowing so as to leave large projecting chitinous wings posteriorly, whilst in the form under discussion the chitinous plate is but little larger than the calcareous portion all round. In *Hemisepius* the chitinous plate is so large as to project far beyond the calcareous centre anteriorly as well as posteriorly.

[1] Céph. acét., Seiches, pl. xxvii. fig. 4.
[2] *Op. cit.*, pl. xvii. fig. 13.
[3] Céph. acét., pl. vi. figs. *a*, *b*, *c*.
[4] Hemisepius, Tab. i. figs. 3, 4, 5.

From these facts we should be inclined to suppose that *Sepia pfefferi* and *Sepia tuberculata* stand in a nearer relation to each other than does either of them to *Hemisepius*, which is clearly marked off by the presence of only two series of flattened suckers on the sessile arms, and the broad shape of the ventral pair of these; by the form of the tentacular club, and by the two rows of glandular pits down its ventral surface.

The three forms seem to constitute together a very aberrant branch of the group, but we have not at present sufficient knowledge to interpret their precise relations to the more ordinary forms. Indeed the problem of the natural relationship of the various species of *Sepia* is far from having been satisfactorily worked out. The shells, which seem in many respects the organs most likely to lead to a solution, can be arranged in series increasing or decreasing in complexity, and there are several interesting fossil genera,[1] which help to bridge over the gulf separating *Sepia* from the Belemnites, but an arrangement of the species based upon the shells does not agree with one based upon the form of the tentacular club, or other parts of the animal's organisation, so that we are hardly justified in regarding it as natural.

Since the above remarks were written I have received, by the kindness of Dr. Appellöf, a copy of his paper on Japanese Cephalopoda,[2] which contains the description of a new species, *Sepia tullbergi*, closely related to the present form. The two agree in the short rounded form of the body, the slight convexity of the anterior dorsal border of the mantle, the depth of the siphono-pallial articulation, the absence of the linear ridge and groove in the nuchal articulation, the disparity in the sizes of the tentacular suckers, and in the form and structure of the shell.

Such being the case, there is no doubt that *Sepia tullbergi* belongs to the group to which I have given the name *Metasepia*.

There are a number of details in which the specimen obtained by the Challenger differs from that described by Appellöf, so that it is impossible to regard them as other than distinct species.

In *Sepia pfefferi* the pits at the base of the funnel for articulation with the mantle are deepest in the middle, not at the anterior end as in *Sepia tullbergi;* there is no trace of any tubercles on the back or head; the teeth of the suckers on the sessile arms are finer and more acute, not so broadly triangular, as indicated in Appellöf's figure (pl. ii. fig. 13); the tentacles are decidedly shorter and the large suckers on the club are not so conspicuous (compare pl. ii. fig. 8, with Pl. XXI. fig. 7 of the present Report, where indeed they are hardly large enough); the denticulation of their horny rings, too, is much finer and not so regular.

The shell agrees in almost every particular with Appellöf's description, except that the posterior extremity, although somewhat thickened, does not give rise to any structure at all like the horny lamella indicated by his figure (pl. ii. fig. 11, *a*).

[1] For interesting remarks on some of these see Lankester, *Quart. Journ. Micr. Sci.*, N.S., vol. xiv. p. 372, 1874.

[2] *K. Svensk. Vetensk. Akad. Handl.*, Bd. xxi. No. 13, pp. 1–40, pls. i.–iii.

Sepiella, Gray, Steenstrup.

This generic name was first informally proposed by Gray [1] in 1849, but no adequate account was given of its characters, until in 1880 Steenstrup [2] published a paper which was then a complete Monograph of the genus, and to which nothing of importance has been added since.

Three conspicuous characters occur in both sexes of all members of this group, which can hardly be expressed better than in Steenstrup's Latin diagnosis, here quoted.

"*Sepiella* . . . . præbet;—

"1. Sepium minus validum, inerme, neque rostro seu mucrone (ut in plurimis Sepiis) neque carina (ut in *Sep. elegante*, d'Orb.) dorsali ornatum.

"2. Fibulam palliarem complicatam, conulo nempe elevato, in profundam cavitatem siphunculo recipiendo instructam.

"3. Saccum subcutaneum, inter sepium et cutem dorsualem pallii situm, valde plicatum, plicis pluries divisis et inter se connexis, apertura sat conspicua in pagina inferiori abdominis inter radices pinnarum præditum."

Steenstrup enumerated two species in this genus, one being the *Sepia ornata*, Rang, the other *Sepia inermis*, v. Hass., of which he showed *Sepia microcheirus*, Gray, to be the female; having recently had the opportunity of examining Gray's types in the British Museum I can fully comfirm all his statements on this head. Last year, however, Dr. Pfeffer described four species and Dr. de Rochebrune another (see p. 25), whilst it seems to me likely that two forms of his *Diphtherosepion* should be referred to this genus.

One very fine specimen was obtained by the Challenger Expedition from the Inland Sea, Japan, which I have not succeeded in certainly identifying with any of the species hitherto described. It does not present any important variation from the definition given of *Sepiella maindroni*, Rochebr., but so many important details are wanting in the description of this type that certainty is impossible, but I have judged it best to apply his name to the Challenger specimen, rather than create a new species unnecessarily.

Sepiella maindroni (*?*), de Rochebrune (Pl. XXII. figs. 1–10).

1884. *Sepiella maindroni*, Rochebr., Monogr. Sepiadæ, p. 89.

Habitat.—Inland Sea, Japan. One specimen, ♀.
Pondichery (de Rochebrune).

I cannot find any difference between the specimen in the Challenger collection and Dr. de Rochebrune's description, but in this latter so many points of specific import-

[1] Gray, Brit. Mus. Cat., p. 106.

[2] *Vid. Meddel. nat. Foren. Kjøbenhavn*, pp. 347-366, 1880.

ance are omitted (even the sex of the specimens not being mentioned), that there is still uncertainty as to the correctness of the identification.

I therefore add details, which are not given by the original describer, but which will show whether or not the two forms are identical.

The Suckers (figs. 2, 3) of the sessile arms are nearly hemispherical, with numerous meridional grooves which pass obliquely towards their distal side; the *horny ring* is smooth, and the *papillary area* unusually wide.

The Suckers of the tentacular club are in about ten rows, hemispherical in form, and mounted on long peduncles (fig. 4); the *horny ring* bears in its distal semicircumference from fifteen to twenty rather irregular conical teeth (fig. 6), and is surrounded by a *papillary area* with three rows of little spines and two of irregular plates (figs. 5, 7).

The Shell (figs. 8, 9, 10) is elliptical in *outline*, except that the posterior extremity is somewhat expanded; the *dorsal surface* has fine rugosities disposed in curves parallel to the anterior margin, and a raised ridge passes along its middle; the *chitinous margin* appears along the edges, and extends some distance beyond them: it is curved downwards and inwards laterally, while posteriorly it expands into the hemielliptical plate characteristic of the genus; the *ventral surface* is elevated so that the shell is thick, the *striated area* is not hollowed but has several slight grooves passing along it from back to front; the *last loculus* has an index of 33, and is bounded posteriorly by a somewhat irregularly waved line. The *inner cone* is represented only by a small fillet of calcareous matter from which the limbs pass forwards as thin tapering strips, which extend forwards along only one-third of the striated area.

The Colour is pale yellowish below, and of a dark slate tint above, with no trace of the remarkable patch over the posterior sac, which is seen in d'Orbigny's figures.[1]

Dimensions.

End of body to mantle-margin,	125 mm.
End of body to eye,	122 „
Breadth of body,	48 „
Breadth of head,	42 „
Eye to edge of umbrella,	28 „
Breadth of fin, average,	10 „

	Right.	Left.
Length of first arm,	43 mm.	42 mm.
Length of second arm,	35 „	36 „
Length of third arm,	40 „	40 „
Length of fourth arm,	45 „	35 „
Length of tentacle,	70 „	...

[1] Céph. acét., Seiches, pl. xx. fig. 1, pl. xxii. fig. 1.

Family IX. LOLIGINEI, Steenstrup.

Sepioteuthis, Blainville.

Sepioteuthis lessoniana, Férussac.

1825.	*Sepioteuthis lessoniana*,	d'Orb.,	Tabl. méth., p. 155 (*nomen tantum*).
1830.	„	„	Lesson, Voy., "Coquille," Moll., p. 241, pl. xi.
1839.	„	„	d'Orb., Céph. acét., p. 301, Sépioteuthes, pls. i. vi. figs. 9–14.
1849.	„	„	Gray, Brit. Mus. Cat., p. 80.
1886.	„	„	Appellöf, Japanska Ceph., p. 31.

Habitat.—From the surface of the harbour, Kandavu, Fiji, August 1874. One specimen, ♂.

Ternate, October 15 to 17, 1874. One specimen, ♂. (Presented by the Resident.)

New Guinea, Java, Cape Fabre, Trincomalee (d'Orbigny); New Zealand (Gray); Japan (Appellöf).

Both the Challenger specimens agree so well with d'Orbigny's description that I have no hesitation in referring them to this species. The individual from Ternate being the largest that has come under my notice, I append its dimensions.

Dimensions.

Length, total,	570 mm.
End of body to mantle-margin,	195 „
End of body to eye,	215 „
Breadth of body,	85 „
Breadth of head,	50 „
Eye to edge of umbrella,	33 „
Breadth of fin,	45 „
Length of hectocotylus,	27 „
Diameter of largest sucker on sessile arm,	4·5 „
Diameter of largest sucker on tentacle,	5·5 „

	Right.	Left.
Length of first arm,	70 mm.	66 mm.
Length of second arm,	85 „	80 „
Length of third arm,	90 „	98 „
Length of fourth arm,	95 „	100 „
Length of tentacle,	320 „	335 „

The hectocotylisation is of the type common in this genus and *Loligo;* it occupies the distal fourth of the arm; the suckers diminish in size and their peduncles become large swollen cones, and eventually these entirely replace the suckers.

Loligo, Lamarck.[1]

Loligo edulis, Hoyle (Pl. XXIII.).

1885. *Loligo edulis*, Hoyle, Diagnoses II., p. 186.
1885. „ „ Hoyle, Prelim. Rep. II., p. 289.

Habitat.—Yokohama, Japan. Purchased in the market. One specimen, ♂.

The Body is moderately stout, being about three times as long as broad, cylindrical in its anterior third, and tapering gradually to a bluntish point. The *fin* occupies a little more than half the length of the body; it is rhomboidal, not quite so broad as long, and broadest anteriorly to the middle; the lateral angles are rounded. The *mantle-margin* has a slight projection in the dorsal median line and a broad shallow sinuate excavation ventrally. The *siphon* is of moderate length and bluntly pointed.

The Head has prominent rounded *eyes*, and the usual auricular crest and preocular pore.

The Arms are unequal, the order of length being 3, 4, 2, 1, and about half as long as the body. The first are very slender and bear a distinct keel on the dorsal aspect; the second are thicker and triangular, and have a broad keel almost expanding into a web on the lateral aspect; the third are the stoutest, flattened from above downwards, and distinctly keeled externally; the fourth are intermediate between the third and second, triangular, and with a broadish web extending the whole way up the dorso-lateral aspect. They all have a web up each side of the inner face. The *suckers* (figs. 3, 4) are in two series, very oblique, and with slender conical peduncles, their size varying with that of the arms on which they are situated; the *horny ring* bears about eight long square-cut teeth on its distal margin. The left ventral arm as usual is *hectocotylised*, and bears proximally ten rows of suckers, then a minute sucker with an exaggerated peduncle, and beyond this two series of long conical papillæ (fig. 5). The *buccal membrane* has the usual seven angles produced into long lappets, each of which bears about eight suckers in two rows; the *outer lip* is moderately thick, the *inner* much thicker and marked with deep radial grooves.

The Tentacles are about as long as the body, with flattened *stems;* about one-third their length is occupied by the *club* (fig. 6), which is only slightly expanded, has a protective membrane on either side, but a dorsal web is present only at the extremity. The central *suckers* (fig. 7) are about sixteen in number and about one-third larger than the lateral; the proximal are about ten, the distal are closely packed in four series. The

[1] Gwyn Jeffreys (Brit. Conch., vol. v. p. 130) gives "Schneider" as the authority for this genus, but without any reference or even date. The only paper by that author bearing in any way upon the subject, which I have been able to find, is one entitled Bemerkungen über die Gattung der Dintenfische (*Schrift. Gesellsch. naturf. Freunde Berlin*, Bd. xi. pp. 33–50, 1794). In it this passage occurs (p. 46), "Ich finde auch damit eine Zeichnung ganz übereinstimmig, welche ich von dem Lungenherze des Kalamers (Loligo) entworfen habe." This does not, however, seem to be of the nature of a definition, and so I have followed the majority of writers in attributing the creation of the genus to Lamarck.

horny rings of the largest suckers (fig. 8) are provided with about twenty larger teeth, with which smaller ones alternate somewhat regularly; the lateral bear about ten distant acute teeth on the outer margin, while the proximal and distal groups are similarly armed on the distal margin.

The Surface is smooth.

The Colour is a dull yellow with purplish chromatophores.

The Gladius (fig. 9) is of the usual form, the narrow anterior portion being less than one-fourth of the total length.

Dimensions.

Length, total,	260 mm.
End of body to mantle-margin,	115 „
End of body to eye,	126 „
Breadth of body,	31 „
Breadth of head,	26 „
Eye to edge of umbrella,	15 „
Length of fin,	67 „
Breadth of fin,	63 „
Breadth of each lobe,	21 „
Length of hectocotylus,	35 „
Diameter of largest sucker on sessile arm,	2 „
Diameter of largest sucker on tentacle,	2 „

	Right.	Left.
Length of first arm,	41 mm.	45 mm.
Length of second arm,	52 „	51 „
Length of third arm,	57 „	60 „
Length of fourth arm,	52 „	51 „
Length of tentacle,	105 „	115 „

Loligo edulis seems to find its nearest ally in *Loligo pealei*, Les., whose habitat is very far removed from its own, but it differs in the form and number of the teeth on the suckers. It is quite clearly distinguished from all other forms from the same region.

Loligo brasiliensis, Blainville.

1823. *Loligo brasiliensis*, Blv., Journ. de Phys., t. xcvi. p. 132.
1833. *Loligo poeyanus*, Fér., Pl. de Calmars, xix. figs. 1–3.
1835. *Loligo brasiliensis*, d'Orb., Amér. mérid., p. 63.
1838. „ „ d'Orb., Moll. des Antilles, t. i. p. 38.
1839. „ „ d'Orb. et Fér., Céph. acét., p. 313; Calmars, pl. xii., pl. xix. figs. 1–3, pl. xx. figs. 1–5.
1853. „ „ d'Orb., Cuba Moll., p. 38.

Habitat:—Station 321, off Monte Video, February 25, 1876; lat. 35° 2′ S., long. 55° 15′ W.; depth, 13 fathoms. Six specimens, 2 ♀, 4 immature.

Coasts of Brazil, the Antilles, Cuba (d'Orbigny).

I have no hesitation in referring these specimens to de Blainville's species; in general appearance they agree rather with the figure of *Loligo poeyana* (*op. cit.*, pl. xix.) than with the one on pl. xii., and in one specimen, at all events, there is a slight notching of the fin at its anterior insertion. There is some discrepancy between d'Orbigny's description and figure (pl. xx. figs. 3, 4) in respect of the horny ring of the large tentacular sucker, which is said to be "armé tout autour de dents . . . . . d'égale grosseur," while the teeth are depicted as distinctly larger along one side of the ring than the other; the Challenger specimens agree with the figure.

The teeth in the suckers of the sessile arms present a slight variation, inasmuch as the three median teeth are considerably narrower than the lateral ones.

A specimen of *Loligo brasiliensis* in the Copenhagen Museum has the teeth of these suckers alternately large and small, showing an interesting approach to *Loligo pealei*, Les. to which this species is undoubtedly nearly related.

The two larger specimens have a distinct spermatic pad within the ventral border of the buccal membrane, very similar to that shown in Pl. XXV. fig. 4.

Loligo kobiensis, Hoyle (Pl. XXV. figs. 1–10).

1885. *Loligo kobiensis*, Hoyle, Diagnoses II., p. 184.
1885. „ „ Hoyle, Prelim. Rep. II., p. 287.

Habitat.—Station 233, Bay of Kobe, Japan, May 17, 1875; lat. 34° 39′ N., long. 135° 14′ E.; 8 fathoms; mud. One specimen, ♀.

Station 233c, Inland Sea, Japan, May 28, 1875; lat. 34° 18′ N., long. 133° 21′ E.; 12 fathoms; blue mud. Four immature specimens.[1]

The Body is cylindrical in the anterior moiety, tapers posteriorly, and ends in a blunt point. The *fin* is more than half the length of the body, trapezoidal, with rounded lateral angles; the extreme breadth is less than the length, and is situated anteriorly to the middle of the fin. The *mantle-margin* presents a triangular process in the mid-dorsal line and is deeply sinuate ventrally. The *siphon* is short and bluntly conical.

The Head is short and not so broad as the body; the *eyes* are comparatively small and have a bow-shaped auricular crest behind and a minute pore in front of them.

The Arms are unequal, the order of length being 3, 4, 2, 1, and, on the average, rather more than one-third the length of the body; the first are the most slender, and have the dorso-median angle raised into a prominent keel; the second have only a faintly-marked angle ventro-laterally; the third have a broad web externally, passing over at the base into one which extends up the dorsal aspect of the ventral arms. The *suckers* (figs. 2, 3) are arranged in two series, pedunculate, very oblique, and rather larger on the lateral than on the other arms; the *horny ring* has about nine short, close-set, square-cut

[1] On the label attached to two of these specimens the locality was marked with a query.

teeth on its distal side, and is smooth on the proximal. The only mature specimen being a female, no *hectocotylus* was observed. The *buccal membrane* has five points, each of which bears two or three small suckers; the two ventral points are rounded off, and just within the ventral margin is a small papilla surrounded by two elevated rings, for the reception of spermatophores (fig. 4). Both the *outer* and *inner lips* are folded.

The Tentacle is faintly three-sided and shorter than the body; the *club* (fig. 5), which is expanded and triangular in section, is one-third as long; it has a protective membrane on either side and a web externally; in the centre are eight large *suckers*, three times the diameter of the lateral ones; at the proximal end are about nine suckers, gradually increasing in size, and at the distal end more than twenty rows arranged in four series, gradually diminishing. The largest suckers are scarcely at all oblique, and have the margin cut up by radial grooves, into a number of small papillæ (figs. 6, 7), an arrangement also found on the outer margin of the lateral suckers, but not in the terminal ones. The *horny rings* of the largest suckers are smooth; those of the lateral and terminal suckers bear about twelve long distant teeth on their outer margin (figs. 8, 9).

The Surface is smooth.

The Colour is pinkish-yellow, with purplish chromatophores.

The Gladius (fig. 10) has the usual form, but the narrow anterior part passes very gradually into the expanded blade.

Dimensions.

Length, total,	163 mm.
End of body to mantle-margin,	85 „
End of body to eye,	88 „
Breadth of body,	19 „
Breadth of head,	16 „
Eye to edge of umbrella,	9 „
Length of fin,	50 „
Breadth of fin,	42 „
Breadth of each lobe,	15 „
Diameter of largest sucker on sessile arm,	1·25 „
Diameter of largest sucker on tentacle,	2·75 „

	Right.	Left.
Length of first arm,	15 mm.	15 mm.
Length of second arm,	22 „	22 „
Length of third arm,	20 „[1]	31 „
Length of fourth arm,	25 „	25 „
Length of tentacle,	62 „	...

The present form differs from all known species of *Loligo* (except *Loligo reynaudii*, d'Orbigny) in the absence of teeth in the large tentacular suckers,[2] these two species

[1] Mutilated.

[2] *Loligo breviceps*, Stp. (Lenz, *Jahrb. Comm. Kiel*, Jahrg. iv. v. vi., Heft 2, Anhang 1, p. 23, 1878), has the teeth on the suckers very variable in size and number, and here and there a perfectly smooth horny ring occurs, but this does not seem likely to be confused with the constant absence of teeth observed in the two species here compared.

being readily distinguishable by the following characters:—*Loligo reynaudii* has sharp-pointed teeth in the suckers of the sessile arms, while in *Loligo kobiensis* they are blunt and closely set. The papillate character of the margins of the tentacular suckers in the latter species is a very remarkable character; it recalls the meridional grooves already described in the suckers of certain species of *Sepia* (see p. 124); and may be a parallel phenomenon with the fringes which are seen in *Loligo vulgaris* from the Mediterranean.

The left ventral arm has a number of spermatophores attached to it (fig. 4*a*), but there are none on the spermatic pad.

Loligo indica, Pfeffer (Pl. XXVI).

1884. *Loligo indica*, Pffr., Ceph. Hamb. Mus., p. 4, fig. 3, 3*a*.

Habitat.—Station 188, Arafura Sea, south of Papua, September 10, 1874; lat. 9° 59′ S., long. 139° 42′ E.; 28 fathoms; green mud. One specimen, ♀.

Station 190, also in the Arafura Sea, south of Papua, September 12, 1874; lat. 8° 56′ S., long. 136° 5′ E.; 49 fathoms; green mud. Twelve specimens, 8 ♂, 4 ♀.

Java (Pfeffer).

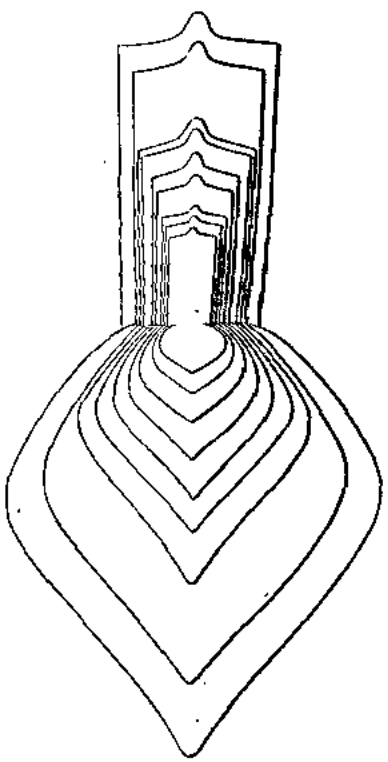

FIG. 8.—*Loligo indica:* outlines of nine specimens showing the proportional growth of the fin, and posterior portion of the body.

I had little doubt that the Challenger specimens were to be referred to the same species as the one which Dr. Pfeffer has obtained from Java, but to place the matter beyond question, I sent him a copy of the drawings which are here published with the request that he would compare it with his types. His reply was that both certainly belonged to the same species, the sole difference being that the fins are a little shorter in the Hamburg specimens.

This species is certainly very near to *Loligo duvaucelii*, d'Orbigny, differing in the number of teeth in the suckers and in the greater slenderness of the pen. Dr. Pfeffer having given merely an outline of the body and pen, I have devoted a plate to the full illustration of the species.

There being a large number of specimens in the collection of very varying sizes, the mode in which the outline of the body varies with increasing growth was brought forcibly before me. The accompanying cut, which shows the outlines of nine individuals, proves conclusively that the growth is most rapid at the posterior end of the

body, for while in the youngest stage examined the fin is much shorter than the anterior cylindrical portion of the body, in the oldest it is considerably longer. This has a very important bearing on the use of the proportionate length of the fin as a specific character; Lafont[1] has given a table of the Loligos of the French coast in which they are subdivided according as the fins are greater or less than half the length of the body. A consideration of the development shows, however, that species are not comparable in this respect unless they have attained the same stage of growth.

Loligo japonica, Steenstrup, MS. (Pl. XXIV. figs. 7–15).

... *Loligo japonica*, Steenstrup, MS. in Mus. Havn.
1885. „ „ Hoyle, Diagnoses II., p. 187.
1885. „ „ Hoyle, Prelim Rep. II., p. 290.

Habitat.—Yokohama, Japan. Purchased in the market. One specimen, ♀.

The Body is only moderately elongated, being about three times as long as broad, and bluntly pointed behind. The *fin* is a little more than half the length of the body, about as long as broad, rhomboidal, rounded laterally, and very slightly notched at the anterior angles. The *mantle-margin* curves gradually forward to a projecting point in the dorsal median line, and is deeply emarginate ventrally. The *siphon* is short and of the usual form.

The Head is comparatively large and rounded; the *eyes* are swollen and prominent.

The Arms are unequal, the order of length being 3, 4, 2, 1, and on an average about half as long as the body; the first are very small, slender, and rounded; the second have a prominent ventro-lateral angle, not amounting to a keel; the third have a distinct web on the outer aspect of the distal portion, which is continued backwards as a faint ridge, which joins the web lying along the dorsal lateral edge of the fourth. The *suckers* are in two series, and vary in size in accordance with the arms on which they are situated; they are subglobular and oblique. The *horny ring* bears about ten broad, closely set, square-cut teeth (fig. 8). The *hectocotylus* was not present in the Challenger specimen, which was a female; but in some examples in the Copenhagen Museum, Professor Steenstrup pointed it out to me, as usual, on the left ventral arm; the distal suckers of the ventral series only are modified into conical papillæ, some of which bear a minute sucker at their tips (fig. 10). The *umbrella* is absent; the *buccal membrane* is well developed and has the usual seven points, each of which bears a few small suckers (occasionally only one). The *outer lip* is thick, thicker than the *inner*; both are cut up into papillæ along the edge.

[1] *Journ. de Conch.*, sér. 3, vol. xii. p. 25, 1872.

The Tentacles are as long as the head and body together, and have very slender, almost cylindrical *stems;* the *club* (figs. 11, 12) occupies about one-fourth of the whole length, and is but slightly expanded. The large central *suckers* are about eight in number and fully twice the diameter of the lateral ones; proximally to them are about half a dozen suckers of different sizes, and beyond them a large number of diminishing ones arranged in four series, and occupying nearly half the length of the club. The *horny ring* in the largest suckers bears about twenty-five square teeth (fig. 14); in the lateral suckers it bears more than twenty close-set acutely-pointed teeth (fig. 13), and in the distal ones about the same number of similar character (fig. 9).

The Surface is smooth.

The Colour is pale, with purplish chromatophores.

The Gladius (fig. 15) is of quite typical form, expanded behind, and about six times as long as broad; the narrow anterior extremity occupies less than one third the total length.

Dimensions.

Length, total,	182 mm.
End of body to mantle-margin,	68 „
End of body to eye,	75 „
Breadth of body,	18 „
Breadth of head,	15 „
Eye to edge of umbrella,	10 „
Length of fin,	40 „
Breadth of fin,	42 „
Breadth of each lobe,	16 „
Diameter of largest sucker on sessile arm,	1·8 „
Diameter of largest sucker on tentacle,	2 „

	Right.	Left.
Length of first arm;[1]	22 mm.	22 mm.
Length of second arm,	30 „	31 „
Length of third arm,	39 „	33 „[2]
Length of fourth arm,	35 „	32 „
Length of tentacle,	92 „	71 „

This specimen agrees so closely with several in the Copenhagen Museum that it is impossible to do otherwise than refer them to the same species. The two most prominent characters of this form are the presence of blunt teeth in the suckers, both in the tentacles and the sessile arms, and the type of the hectocotylisation; this consists in the modification of the suckers of *only one* series (that on the ventral aspect of the arms) into conical papillæ, the suckers persisting, although reduced in size, on the other.

This form, therefore, bears a curious relation to *Loligo bleekeri*, Keferstein, from the same region, in which the dorsal series is thus modified.[3]

[1] The lengths of the arms are measured from the oral margin.

[2] Mutilated.

[3] See Bronn, Klass. u. Ord. d. Thierreichs, Bd. iii., pl. cxxii. fig. 10.

It is clearly distinguished from that species, however, by the following characters:[1] (1) the length of the arms, which are about half the length of the body and not one-fifth; (2) the size of the tentacular suckers, which are much larger than those of the sessile arms, (3) the form of the gladius (compare fig. 15 with Keferstein's drawing),[2] and (4) the denticulation of the horny rings of the suckers.[3]

Loligo galatheæ, Steenstrup, MS. (Pl. XXVII.).

...	*Loligo galatheæ*,	Steenstrup,	MS. in Mus. Havn.
1885.	„	„	Hoyle, Diagnoses II., p. 183.
1885.	„	„	Hoyle, Prelim. Rep. II., p. 286.

Habitat.—Station 203, off Panay, Philippine Islands, October 31, 1874; lat. 11° 6′ N., long. 123° 9′ E.; 20 fathoms; mud. Two immature specimens.

The Body is about four times as long as broad, cylindrical anteriorly, and pointed behind. The *fin* is rather less than half the length of the body, about as long as broad, and with rounded lateral angles. The *mantle-margin* curves out rapidly to a triangular process in the dorsal median line, for the rest it is almost transverse, except where it forms two obtuse angled processes, one at either side of the ventral emargination, which receives the siphon.

The Head is comparatively broad and with rather prominent rounded *eyes*. The *siphon* is moderately large and of the usual form.

The Arms are unequal, the order of length being 3, 2, 4, 1, and about half as long as the body. The dorsal have a distinct keel on the upper margin, the second are keeled on the ventro-lateral aspect, the third are stout and flattened and have a broad web on the outer aspect, which unites with the web running up the dorso-lateral aspect of the ventral arms. The *suckers* (fig. 2) are in two series throughout, with short peduncles, and not very oblique; their horny rings bear nearly twenty distant blunt teeth (figs. 3, 4). The left ventral arm is hectocotylised for about two-thirds of its length (fig. 5); there being as usual two rows of conical papillæ. The papillæ of the dorsal series are decidedly smaller than the others and bear each a minute sucker at the tip (fig. 6). Those of the ventral series are stouter and not so evenly conical as the others, tapering more rapidly towards their tips; they bear also a somewhat elevated oval patch on one or both their sides, and a few of the proximal ones have each a small sucker at the tip (figs. 7, 8). At the base of the arm, lying transversely across it is an oval raised cushion with a rough papillate surface (fig. 5). The *umbrella is absent*. The *buccal membrane* has the usual seven points, each of which bears a few suckers. The *outer lip* is thin, the *inner* thin and papillate.

[1] Brock, *Zeitschr. f. wiss. Zool.*, Bd. xxxvi. p. 604, 1882.
[2] Bronn, *op. cit.*, pl. cxxvii. fig. 14.
[3] Compare Appellöf's figures (Japanska Ceph., pl. i. figs. 9, 10) with those given in the present Report.

The Tentacles are comparatively short, being not quite so long as the body; the *stems* are subtriangular. The *club* occupies less than one-third of the length, and has a protective membrane at either side of the suckers and a distinct web on the outer aspect. The large central *suckers* are eight to ten in number, and nearly twice the diameter of the lateral ones (fig. 9); the proximal group consists of about ten, while the distal portion bears four series of diminishing suckers. The *horny ring* bears long, distant, blunt pointed teeth, about twenty-four in the largest suckers (fig. 10), proportionally fewer in the smaller (fig. 11), which are much larger in the distal and external portions of the ring respectively.

The Surface is smooth.

The Colour is pale yellowish, spotted with brownish-purple and red chromatophores.

The Gladius (fig. 12) is of the usual form, the narrow anterior portion being comparatively broad and about one-fourth of the total length.

The description of this species given in the Preliminary Report has been modified in accordance with a drawing of an adult specimen in the Copenhagen Museum, which I received from Professor Steenstrup, and which is reproduced in Pl. XXVII.; the Challenger specimens were so small that it was not worth while to give dimensions of them.

Loligo (?) *ellipsura*, Hoyle (Pl. XXIV. figs. 1–6; Pl. XXV. figs. 11–15).

1885. *Loligo ellipsura*, Hoyle, Diagnoses, II., p. 182.
1885. „ „ Hoyle, Prelim. Rep. II., p. 285.

Habitat.—Station 313, off Cape Virgins, Patagonia, January 20, 1876; lat. 52° 20′ S., long. 67° 39′ W.; 55 fathoms; sand. One specimen, ♀.

The Body is elongated, widest anteriorly, and tapering gradually to an acute point behind. The *fin* is comparatively short, only one-third the length of the body, elliptical, slightly broader than long. The *mantle-margin* passes almost straight across the back, except where a long narrow median process juts out over the head (Pl. XXIV. fig. 2); it is slightly sinuate ventrally (fig. 1). The *siphon* is short and blunt.

The Head is short and very nearly as broad as the body; it has the usual auricular crest and pre-ocular pore.

The Arms are unequal, the order of length being 3, 4, 2, 1, and about one-third the length of the body; the first has a distinct web on its dorso-median angle, and the third a still broader web on its outer aspect, passing back nearly as far as the eye, where it becomes connected with another passing up the dorso-lateral aspect of the fourth. The *suckers* (figs. 4, 5) are in two series, pedunculate, oblique, notched distally, and somewhat larger on the lateral than on the other arms. The *horny ring* bears from five to seven

large pointed teeth in its distal portion, but is smooth proximally. The only specimen being a female the *hectocotylus* is not developed. The *buccal membrane* has the usual seven points, each of which carries two or three small suckers. The *outer lip* is thick and marked with radial grooves; the *inner* was not seen.

The Tentacle is slender, approximately cylindrical, and about two-thirds the length of the body; its terminal fourth is occupied by the *club* (Pl. XXV. fig. 11), which is but little expanded, and has a delicate protective membrane along either side of the inner surface and a well-marked web externally. The large median *suckers* (figs. 12, 13) are about ten in number, and about twice as large as the alternating lateral; the proximal are about twenty, and gradually increasing; the distal occupy nearly one half the club, and are in four series, diminishing. The *horny rings* of the largest suckers (fig. 14) have about twenty-four distant square pointed teeth, much longer on the distal margin; and are surrounded by a papillary area, consisting of two rows of plates succeeded by radial markings (Pl. XXIV. fig. 3); the lateral ones have about half as many similar teeth on the outer margin (fig. 6), and the terminal suckers are armed in the same way.

The Surface has been almost entirely denuded of skin.

The Colour appears to have been pale buff with purple chromatophores.

The Gladius (Pl. XXV. fig. 15) has the anterior narrow portion very long in comparison with the broader portion, but this is probably correlated with the small size and presumable immaturity of the specimen, for the posterior portion of the body grows more rapidly than the anterior (see p. 156).

Dimensions.

End of body to mantle-margin,	43 mm.
End of body to eye,	45 „
Breadth of body,	11 „
Breadth of head,	9 „
Eye to edge of umbrella,	5 „
Length of fin,	13 „
Breadth of fin,	18 „
Breadth of each lobe,	5 „

	Right.	Left.
Length of first arm,	14 mm.	15 mm.
Length of second arm,	17 „	17 „
Length of third arm,	18 „	20 „
Length of fourth arm,	16 „	16 „
Length of tentacle,	...	30 „

This species approaches *Loligo brasiliensis*, Blainville, in some respects; both have a rounded fin, although the shape is much more nearly elliptical in the present form, and both have blunt squarish teeth in the suckers of the arms and sharper ones in those of the tentacles; *Loligo ellipsura* has, however, only about five complete teeth in the arm-suckers and nineteen in the tentacular, whilst in *Loligo brasiliensis* the numbers are eight

and twenty-eight respectively, while the shapes are clearly distinct (compare d'Orbigny, Céph. acét., pl. xx. figs. 1–5).

It also resembles in its rounded fin *Lolliguncula brevis* (Blv.), but it differs from it in the greater slenderness of its body and correspondingly narrower fin, the teeth of the suckers too are different both in number and form; compare the figures here given with those of d'Orbigny, Céph. acét., pl. xxiv. figs. 14–19. Very probably it should be placed in the genus *Lolliguncula*, which is distinguished by the spermatophores being attached to a spot over the left gill in the female. The Challenger specimen bore no spermatophores, so that it is impossible to be certain of its true position. The male of *Lolliguncula brevis* has not yet been described.

Division II. ŒGOPSIDA, d'Orbigny.

Family X. Ommastrephini, Steenstrup.

Subfamily, Ommastrephidæ, Gill.

Ommastrephes, d'Orbigny.

Ommastrephes oualaniensis (Lesson), d'Orbigny.

1830. *Loligo oualaniensis*, Less., Voy. "Coquille," Zool., p. 240, pl. i. fig. 2.
1832. „ *vanicoriensis* Q. et G., Voy. "Astrolabe," t. ii. p. 79, pl. v. figs. 1, 2.
1832. „ *brevitentaculata*, Q. et G., *Ibid.*, p. 81.
1839. *Ommastrephes oualaniensis*, d'Orb., Cèph. acèt., p. 351; Calmars, pls. iii., xxi.; Ommast., pl. i. figs. 14, 15.
1862. „ *tryonii* (*?*), Gabb, Proc. Acad. Nat. Sci. Philad., p. 483, with plate.
1863. „ *ayresii* (*?*), Gabb, Carpenter, Rep. W. C. Moll., p. 613.
1880. *Ommatostrephes oualaniensis*, Stp., Ommat. Blækspr., pp. 76, 84, &c.

Habitat.—Between Api, New Hebrides, and Cape York, August 22, 1874. From the stomach of a specimen of *Sula piscator* which alighted on the ship. Eight specimens.

Pacific Ocean, $2\frac{1}{2}^{\circ}$ north of the Admiralty Island, March 13, 1875; surface. One specimen.

Oualan Island (Lesson); Island of Vanikoro (Q. and G.); Pacific Ocean, "dans toute son étendue" (d'Orbigny); Indian Ocean, Cape of Good Hope (Tryon).

This species is readily distinguished from all others of the family in that the mantle has developed on either side an adhesion to the base of the siphon. The specimens were in bad condition and did not present any points worthy of special notice.

A young *Ommastrephes* of undetermined species was captured in the surface-net on April 29, 1876, which is interesting because, though only 5 mm. long, it showed the peculiar form of mantle-connective characteristic of the genus.

Todarodes, Steenstrup.

Todarodes pacificus, Steenstrup (Pl. XXVIII. figs. 1–5).

1880. *Todarodes pacificus*, Steenstrup, Ommat., Blackspr., pp. 83, 90, &c.
1886. *Ommastrephes pacificus*, Appellöf, Japanska Ceph., p. 35, pl. iii. figs. 8–10.

Habitat—Inland Sea, Japan; May 25 to 29, 1875. One immature specimen. Hakodadi, Japan (Steenstrup); Japan (Appellöf).

This species may be readily distinguished from *Todarodes sagittatus* (*Ommastrephes todarus*, d'Orb. et auctt.) by the following characters :—

1. The body is evenly cylindrical, and does not taper so rapidly posteriorly.

2. The tentacular suckers do not make their appearance until nearly halfway along the arm, whereas in *Todarodes sagittatus*, they begin close to the base.

3. The suckers of the sessile arms have subequal teeth (eight or nine in number) on the distal semi-circumference of the horny ring, while in *Todarodes sagittatus* there are seven teeth, of which the central one is much larger than the others.

The small specimen obtained by the Challenger had lost a good deal of its epidermis, but still it agreed very closely with the type specimens in the Copenhagen Museum, the chief differences being the greater relative shortness of the fin and of the tentacles, both of which may be referred to its immaturity. It was so small that a figure of it would have been of no service, and I am indebted to Professor Steenstrup for the drawings by Mr. Thornam, which are reproduced on Pl. XXVIII.

Tracheloteuthis, Steenstrup.

Verrilliola, Pfeffer.
Entomopsis, Rochebr. (?).

This genus has been described by its founder as follows :[1]—

"These forms have the eye furnished with a *sinus*. The siphon with a *valve*, the head with *aquiferous chambers* at the bases of the arms, but neither on the arms nor on the tentacles have they hooks instead of rings on the suckers, and hence, according to the present state of our knowledge, they must be classed among the Œgopsids beside *Ommatostrephes* and *Architeuthus*.

"The small specimens hitherto obtained, only 2 to 4 inches long, have many characters in common with *Architeuthus*—only two suspensory ligaments to the funnel, only a very long ridge on each side of the mantle and a trough- or groove-shaped hollow on either side of the siphon, together with relatively long tentacles, which have long clubs,

[1] *Vid. Meddel. nat. Foren. Kjøbenhavn*, p. 293, 1881.

whose proximal more slender portion is furnished with small closely placed suckers, while the distal part bears much larger ones.

"They are distinguished, on the contrary, by the much weaker musculature of the mantle (very little more powerful than in *Cranchia Reinhardtii*) and their more elongated form, more expanded fins one-third to one-fourth the length of the mantle, the great inequality in the length of the arms, and especially the preponderance of the lateral arms over both the ventral and dorsal, both in length and stoutness. When the mantle is divided along the ventral median line two peculiarities are observed: the position of the viscera in an aggregated mass far back in the mantle-cavity, with the rectum projecting from it, but so short that the anus with its two appendages lies about midway in the mantle-cavity and far from the base of the siphon; also the long and broad musculi depressores infundibuli, which extend backwards meeting in the middle line. The formula of the arms 2, 3, 4, 1.

"The *gladius* can be seen through the almost transparent, or at all events translucent mantle, in the form of a long, almost linear streak, until it approaches the base of the fins; here it expands into a broad lance-shaped blade, whose two margins bend over and form a hollow cone posteriorly. It closely resembles the figure of *Conoteuthis* given by d'Orbigny."[1]

Tracheloteuthis riisei, Steenstrup (Pl. XXVIII. figs. 6–12).

1881. *Tracheloteuthis Riisei*, Stp., Vid. Meddel. nat. Foren. Kjøbenhavn, p. 294.
1884. *Verrilliola gracilis* (?), Pffr., Ceph. Hamb. Mus., p. 22, fig. 28.

Habitat.—Station 2, Færöe Channel, H.M.S. "Knight Errant" Expedition, July 28, 1880; lat. 60° 29′ N., long. 8° 19′ W.; surface. One specimen.

Atlantic, Mediterranean (Steenstrup); Solomon Islands (Pfeffer).

The Body is cylindrical in its anterior two-thirds and then tapers rapidly to a point. The *fin* is very little more than one-third the length of the body, and considerably broader than long; it is cordate in shape and is notched at its anterior insertion (fig. 6). The *mantle-margin* is transverse, slightly convex dorsally. The *mantle-connective* consists of an elongated cartilaginous groove and ridge in the nuchal region, and of a linear ridge on either side of the mantle fitting into a corresponding groove at the base of the *siphon;* which is short, subulate and deeply notched in the middle line behind (fig. 7). It is provided with a small valve; and has two long suspensory ligaments connecting it with the head. The furrow in which it lies is shallow.

The Head is narrower than the body except for the *eyes*, which in the present

[1] Moll. viv., pl. xxxii. figs. 1, 4.

specimen were globular and protruded from their sockets, so that the presence or absence of a sinus in the eyelid could not be determined.

The Arms are very unequal, the order of length being 2, 3, 4, 1; the longest are rather more than half the length of the body; the shortest about one-fifth. They are quadrilateral in section; the third pair bear a distinct but narrow web up the outer aspect and the fourth pair a keel on the dorso-lateral angle. There is no membrane bounding the sucker-bearing face. The *suckers* (fig. 8) are in two series throughout, and placed upon subulate conical peduncles, they are spheroidal and oblique and the *horny ring* bears in its distal semicircumference about eight or ten broad, square-cut teeth, standing close together. No trace of a *hectocotylus* was observed on the single specimen in the collection. The bases of the arms are not connected by any *umbrella*. The *buccal membrane* is thin, has seven blunt points, and is connected with the arms by ligaments in the usual way.

The Tentacles are about as long as the body and have slender subcylindrical *stems*. The *club* (fig. 9) is but slightly expanded, and has no protective membranes and no web. The wider portion is covered with about nine series of minute *suckers*, which have very long slender peduncles springing from a conical base and smooth *horny rings* (fig. 12). The narrow terminal part of the club bears about four series of much larger *suckers* (fig. 10), which are also mounted on large peduncles: their *horny ring* is armed in its distal semicircumference with about fourteen long acute teeth, and on its proximal margin with ten or twelve blunt quadrate teeth. The *suckers* at the extreme tip of the club resemble those last mentioned, but are smaller, and the proximal half of the *horny ring* is smooth (fig. 11). At the proximal end of the club the peduncles of the suckers become shorter till these are almost sessile. They extend for a considerable distance down the stem, but it was impossible to ascertain exactly how far. No fixing cushions could be seen, though their absence cannot be regarded as proved.

The Surface is smooth.

The Colour is white, probably transparent when alive, with elongated, reddish chromatophores here and there.

The Gladius was not extracted; it had been damaged near the anterior end of the fin, but it was possible to see that it forms a hollow cone posteriorly.

Dimensions.

Length, total,	67 mm.
End of body to mantle-margin,	32 „
End of body to eye,	35 „
Breadth of body,	8 „
Length of fin,	13 „
Breadth of fin,	19 „

	Right.	Left.
Length of first arm,[1]	8 mm.	8 mm.
Length of second arm,	18 „	...
Length of third arm,	...	15 „
Length of fourth arm,	13 „	13 „
Length of tentacle,	...	32 „

The specimen under consideration was only placed in my hands quite recently, so that I have not had the opportunity of comparing it with Professor Steenstrup's specimens; hence its identification cannot be regarded as certain, the more so as the original diagnosis of the species is very short, being in fact not a diagnosis but merely an indication of the characters which distinguish it from the only other form (*Tracheloteuthis behnii*) known to the author.

I cannot be sure of its identity with *Verrilliola gracilis*, Pfeffer; there are one or two points in his description which may indicate specific distinctness, but they seem to me unimportant.

Tracheloteuthis (*?*) sp. (Pl. XXXI. figs. 6–10).

Habitat.—South Pacific, November 5, 1875; surface at night. One specimen.

November 11, 1875; surface. Two specimens (stained with carmine and mounted in glycerine as microscopic objects).

Færöe Channel, August 8, 1882; surface. One specimen.

Pl. XXXI. figs. 6, 7 represents a young Cephalopod which I have been unable to refer to any species hitherto described, but it is so exceedingly immature that it would not be justifiable to make it the type of a new species, and I therefore content myself with publishing these drawings and a few remarks, in the hope that at some future time it may find its true systematic position.

The Facies of the specimen is exceedingly like that of a *Cranchia*, so that in my first examination of the Challenger material I referred it to that group without any hesitation; closer examination failed to disclose the three connections between the mantle and the head, even though in order to obtain complete certainty in this point I dismounted one specimen and made an incision down the ventral aspect of the mantle.

The Body is subcylindrical, elongated, and comparatively very large, presenting in this respect a marked contrast to *Loligo*, *Sepia*, and other forms whose young stages are well known. The *fins* are small and terminal, and so folded that their true shape is difficult to determine, but they appear each to have been transversely oval. The *mantle-cavity* is as large as in *Cranchia*, *Taonius* or *Tracheloteuthis*, and in the mounted specimens in which it has become apparently wider, owing to compression, the head at the end of a kind of stem projects from it like a clapper from a bell. The *siphon*

[1] Measured from the eye.

(Pl. XXXI. fig. 9) is short, entirely concealed within the mantle, and recurved, and at its base bears an elongated, oval, articular depression for articulation with the mantle, the corresponding part of which consists of a fine linear ridge, as in the Onychians, Taonoteuthids and *Tracheloteuthis;* it is connected with the head by two rudimentary but distinct ligaments, and has the prominent musculi depressores infundibuli which form such a striking character of the last mentioned form. I was unable to ascertain whether a valve is present. It agrees with *Tracheloteuthis* also in the posterior position of the viscera.

The Head is long, the *eyes* occupying the antero-inferior angles of it (fig. 8); the bright shining spherical lenses are clearly visible protruding from the body of the eye; over each eye is a chromatophore. The *mouth* is elevated on a process longer than the arms.

The Arms are quite rudimentary, the second pair being the longest, the others subequal; they bear one or two suckers.

The Tentacles are short and stout without distinct clubs, but with suckers in four rows at the extremities, and reaching down the greater part of the stem.

The Gladius extends the whole length of the mantle, and is linear, somewhat expanded behind.

Dimensions.

Length, total,	about 14 mm.
End of body to mantle-margin,	9 ,,
Breadth of body,	3 ,,
Breadth of head,	2 ,,
Length of tentacle,	about 3 ,,

Bathyteuthis, Hoyle.

Bathyteuthis, Hoyle, Narr. Chall. Exp., vol. i. p. 272, May 1885.
Benthoteuthis, Verrill, Third Catal., p. 401, July 1885.

Body long, cylindrical, tapering but slightly behind; *fins* subterminal, small and rounded; *mantle-connective* an elongated linear ridge fitting into a similar shorter groove on the base of the *siphon*, which is provided with a valve but has no dorsal bridles.

Head large, very broad, with prominent eyes.

Arms very short, slender and conical; *suckers* very minute and in two or four series. *Buccal membrane* large, with seven points, each bearing one or two suckers.

Tentacles long slender, without expanded clubs, but with numerous minute suckers.

Gladius resembling that of *Ommastrephes* in front but expanded in the posterior third.

Bathyteuthis abyssicola, Hoyle (Pl. XXIX. figs. 1–7).

1885. *Bathyteuthis abyssicola*, Hoyle, Narr. Chall. Exp., vol. i. p. 272, fig. 108.
1885. „ Hoyle, Prelim. Rep. II., p. 309, fig. 2.

Habitat.—Station 147, Southern Ocean, between Marion Island and the Crozets, December 30, 1873; lat. 46° 16′ S., long 48° 27′ E; 1600 fathoms; Diatom ooze. One specimen.

The Body is subcylindrical, somewhat narrowing towards and bluntly rounded at the posterior extremity. The *fins* are small, separate; each is somewhat rectangular in shape, with rounded angles, and attached to the body by one angle. The *mantle-margin* is almost transverse, but projects slightly in the dorsal median line, and forms a shallow sinus behind each eye and the siphon. The *mantle-connective* (fig. 2) consists of a long linear ridge, extending quite to the margin, and fitting into a corresponding, but somewhat shorter and broader, groove on the base of the *siphon*, which is short, tapering, and bluntly pointed, and fits into a shallow depression below the head, but has no dorsal bridles.

The Head is much broader than the body, being distended laterally by the enormous eyes, which look outwards and forwards, and have bright, prominent, glistening lenses.

The Arms (fig. 3) are unequal, the order of length being 4, 3, 2, 1, and about one-fourth the length of the body: they are all conical, and taper to slender points; each has a distinct angle along the outer side, which expands to a distinct web in the fourth pair; there is also a very narrow delicate web along each side of the sucker-bearing face. The *suckers* (fig. 4) are very minute, pedunculate, and are arranged in two irregular rows, almost embedded in the arm; they are spheroidal, the horny ring has five or six blunt-pointed teeth and is surrounded by two or three rows of conical papillæ. No *hectocotylisation* was observed in the specimen. The *buccal membrane* (fig. 3) is very large, has the usual seven points, connected by ligaments with the arms; each point bears one or two suckers.

The Tentacles are almost equal in length to the head and body together; the *stem* is very slender, cylindrical, and grooved along the inner aspect (fig. 5); they taper away rapidly towards the extremity, no *club* being formed: the *suckers* cover only the distal eighth of the tentacle in its inner aspect; they are smaller than those of the sessile arms, and almost imperceptible to the naked eye; they are urn-shaped, and have a smooth horny ring, surrounded by about two rows of very small papillæ (fig. 6).

The Surface is covered with minute wrinkles, probably due to the action of the spirit.

The Colour is a very deep purplish-brown.

The Gladius (fig. 7) was unfortunately somewhat damaged; for the anterior two-thirds it resembles that of an *Ommastrephes*, but posteriorly it expands into a broad blade resembling that of *Loligo;* although somewhat damaged during the extraction it was still

possible to ascertain that it does not form a terminal cone like that of *Ommastrephes* or *Tuonius*.

Dimensions.

End of body to mantle-margin,	40 mm.
End of body to eye,	50 „
Breadth of body,	14 „
Breadth of head,	18 „
Eye to edge of umbrella,	10 „
Length of fin,	7 „
Breadth of fin,	16 „
Breadth of each lobe,	6 „

	Right.	Left.
Length of first arm,	16·5 mm.	16 mm.
Length of second arm,	16 „	16 „
Length of third arm,	15 „	15 „
Length of fourth arm,	15 „	15 „
Length of tentacle,	55 „	45 „

Notwithstanding the great distance between the localities where this species and Verrill's *Benthoteuthis megalops*[1] were captured, it seems quite possible that they may ultimately prove to be the same species. The chief differences seem to be the absence of the angular sinus in the eyelid in the Challenger specimen, the greater comparative size of the head, (though this may be explicable by the individual being smaller), and the suckers on the sessile arms being for the most part in two, not in four, series; but the two rows in the Challenger specimen are very irregular, and if but slightly more so might easily be regarded as four.

Verrill has called attention to certain embryonic characters in this genus, which are certainly very striking, namely, the size and position of the fins, the short arms, and more particularly the shape of the head, with the eyes situated at the anterior angles of a roughly quadrate mass.

The pen is very remarkable, exhibiting a combination of the characters of *Ommastrephes* and *Loligo*; I greatly regret that the posterior extremity was damaged in extracting it so that I have been unable to depict the extreme end on the plate; the dotted line indicates what seemed to have been the original form.

Certain other structural peculiarities of this animal seem to fit it for an abyssal existence; the small fins are in marked contrast to those of most pelagic species, although some genera which are characteristic surface forms such as *Cranchia* and *Idiosepius* have fins quite as small: the minute suckers and delicate tentacles appear but little fitted for raptorial purposes; while on the other hand the large circumoral membrane would seem well adapted for collecting nutritive matters from an oozy bottom.

It is uncertain to what family this form rightly belongs; it is possible that a new one will eventually be required for its reception.

[1] Third Catal., p. 402.

Subfamily MASTIGOTEUTHIDÆ, Verrill.

Mastigoteuthis, Verrill.

Mastigoteuthis agassizii, Verrill (Pl. XXIX. figs. 8–10).

1881. *Mastigoteuthis Agassizii*, Vll., "Blake" Rep., p. 100, pls. i., ii. figs. 2, 3.
1881. „ „ Vll., Ceph. N. E. Amer., p. 297, pls. xlviii., xlix. figs. 2, 3.
1884. „ „ Vll., Second Catal., p. 243.

Habitat.—Station 2, south-west of Tenerife, Febuary 17, 1873; lat. 25° 52′ N., long. 19° 22′ W.; 1945 fathoms; Globigerina ooze. Fragments of a tentacle, found adhering to the dredge rope.

Off North Carolina, U.S.A; lat. 33½° to 34½° N., long. 75½° to 76° W., and 647 to 1632 fathoms (Verrill).

When these fragments were obtained Dr. von Willemoes-Suhm mounted several of the suckers as microscopic objects, and his diary has the following mention of the occurrence: "The arms of a cuttle-fish were brought up having suckers which show a horny denticulation of the finest arrangement. See preparations."

From these preparations the drawings on Pl. XXIX. have been made, which show the tentacular suckers to be hood-shaped, with a rather small aperture and a horny ring bearing from six to eight strong, pointed teeth, and surrounded by a broad papillary area, with two rows of spinous papillæ.

A thickened band of the horny material extends round the posterior and proximal part of the sucker, where it is visible through the integuments (fig. 9).

The fragments picked up by the Challenger have a combined length of 42 cm. or about one-third longer than the tentacle measured by Verrill.

The sucker-bearing portion is about 18·5 cm. long, and the greatest diameter (4 mm.) is about 7 cm. from the extremity; at the proximal part of the sucker-bearing portion the diameter has diminished to 3·5 mm. and a fragment which was apparently still nearer the base measures only 2·75 mm. From these dimensions it may be concluded that the specimen was of considerably greater magnitude than the larger of the two measured by Verrill, its total length from the posterior extremity to the end of the sessile arms having presumably been about 30 cm.

No portion of the present tentacle (of which the extreme tip has fortunately been preserved) is entirely surrounded by suckers, as Verrill indicates to have been the case with his examples, although his figure (*op. cit.*, pl. xlviii.) hardly agrees with this; and at the widest portion of the tentacle almost exactly half its circumference is covered by suckers.

This difference, and also the fact that the tentacle instead of tapering gradually

throughout its whole length as stated by Verrill, is distinctly thickened in the middle of the club may indicate specific or varietal distinctness, but with our present knowledge it would be very undesirable to give this formal expression.

Family XI. Onychii, Steenstrup.

Subfamily Onychoteuthidæ, Gray.

Enoploteuthis, d'Orbigny.

Enoploteuthis margaritifera, Rüppell (Pl. XXIX. fig. 11).

1844.	*Enoploteuthis margaritifera*,	Rüppell., Giorn. Gab. Messina, t. xxvi. p. 2, fig. 1.
1851.	„	„	Vér., Céph. médit., p. 82, pl. xxx. fig. a.
1858.	„	„	Claus, Archiv f. Naturgesch., Jahrg. xxiv., Bd. i. p. 262, Taf. x. fig. 2.
1879.	„	„	Tryon, Man. Conch., vol. i. p. 172.

Habitat.—Station 195, off Amboina, October 3, 1874; lat. 4° 21′ S., long. 129° 7′ E.; 1425 fathoms; blue mud. One specimen.

Station 271, Central Pacific, September 6, 1875; lat. 0° 33′ S., long. 151° 34′ W.; 2425 fathoms; Globigerina ooze. One specimen.

Mediterranean (Rüppell, Vérany, Claus).

These two specimens were found at localities widely separate from each other, and from the original habitat of the species, but still they exhibit no characters which would justify their separation. The specimen from the Central Pacific does not possess the round spots under the eye from which the specific name is derived, but since these are invisible below one eye of the other individual, and indistinct below the other, I do not think that much stress can be laid upon this.

The number of hooks upon the tentacular arms appears to vary between three and four; and the body is more slender and the fin more rounded than in Vérany's figure, approximating to that of Claus (*loc. cit.*).

Tryon's account of this species (*loc. cit.*) contains a mistake which can only be the result of his having translated Vérany without taking the trouble to read the context. He says "distinguished . . . . by the sessile arms having two rows of cups and one of hooks." It is true this is an exact rendering of Vérany (*op. cit.* p. 83), but if Mr. Tryon had reflected upon this statement for a moment, he would have perceived that an animal with such a character could not possibly belong to the genus *Enoploteuthis*, and if he had taken the trouble to read Vérany's description on the preceding page he would have seen the sessile arms described thus: "Tous ces bras sont armés d'une double rangée de tubercules charnus, enveloppant une griffe;" while the tentacles are described as "terminiés

par une massue lanceolée, armée d'une double rangée de très petites cupules sessiles, dont les plus grosses sont celles de la base, et d'une rangée latérale de quatre griffes." The conclusion from which is unavoidable, that in the passage translated there is a misprint or *lapsus calami* of "sessiles" for "tentaculaires."

Whence Tryon's statement (*loc. cit.*) that there are "two specimens only known" is derived I cannot say; Gray[1] mentions the existence of two examples in the British Museum (which are still preserved) presented to him by Rüppell, who probably did not part with the whole of his collection.

Tryon's definition of the genus *Enoploteuthis* (*op. cit.* p. 107) is inaccurate; the phrase "tentacles with hooks only" is contradicted by the figure he himself gives (pl. lxxv. fig. 317, copied from Vérany) of the tentacle of this very form. Vérany's figure is, however, not very accurate, and I have therefore given one taken from the specimen from Amboina (fig. 11); this shows the proximal group of suckers not only to be much larger than indicated in the above-mentioned drawing, but to consist partly of suckers and partly of fixing cushions ("Hæftepuder," Steenstrup). The hooks vary in number between three and four; the club from which the drawing was made had only two, but as there was a vacant space from which it had evidently fallen out I have supplied the deficiency.

Onychoteuthis, Lichtenstein.

Onychoteuthis, sp.

Habitat.—Off Valparaiso, October 21, 1875, between the surface and 30 fathoms; and North Atlantic, April 12, 1876; surface. Too young and ill preserved for determination.

Teleoteuthis, Verrill.

Onychia, Lesueur.
Onychoteuthis, Auctt. (*pars*).

Teleoteuthis caribbæa (Lesueur), Verrill (Pl. XXX. figs. 1–8).

1821. *Onykia carribæa*, Les., Journ. Acad. Nat. Sci. Philad., vol. ii. p. 98, pl. ix. fig. 1, 2 *a–e*.
1836. *Loligo laticeps*, Owen, Trans. Zool. Soc. Lond., vol. ii. p. 108, pl. xxi. figs. 6–11.
1837. *Cranchia perlucida*, Rang, Mag. de Zool., pl. xciv.
1839. *Onychoteuthis cardioptera*, d'Orb., Céph. acét., p. 333; Cranchies, pl. iv.; Onychot., pl. v. figs. 4–6 (*pars ?*).
1849. *Onychia cardioptera*, Gray, B.M.C., p. 57.
1851. *Loligo alessandrinii* (*?*), Vér., Céph. médit., p. 99, pl. xxxv. figs., f. g. h.
1880. *Onychia caribæa*, Stp., Ommat. Blækspr., p. 96.
1882. *Teleoteuthis carribæa*, Vll., Ceph. N. E. Omer. (Fish Comm. Rep.), p. 70.

Habitat.—North Atlantic, between St. Thomas, West Indies, and Bermuda; surface. Three specimens.

[1] B. M. C., p. 48.

?North Pacific, off Volcano Island, April 3, 1875; about lat. 24° 49′ N., long. 138° 34′ E.; surface. Three specimens.

?North Pacific, near the same locality, April 5, 1875; surface. One specimen.

Gulf of Mexico, Gulf Stream, "amongst fuci" (Lesueur), North Atlantic, surface (Owen), Atlantic Ocean (d'Orbigny, Steenstrup).

The specimens marked with a query are small and badly preserved, so that their identification is by no means certain; some doubt is also thrown upon it by the fact that the species has not hitherto been found except in the Atlantic, but in a creature of such pronounced pelagic habit much stress need not be laid upon this.

Owen's figure of the whole animal is very good, but no satisfactory drawing of the club appears yet to have been published, so I give one of it.

The tentacular club (fig. 1) is only slightly expanded, but has a broad web along its distal half. On the proximal portion ("wrist" of various authors) it bears a group of seven to nine suckers, and the same number of fixing cushions, beyond which are four series of hooks and suckers, the latter being situated along the margins, the former in the centre. The first transverse row contains suckers only, the second has two suckers outside, and between them two whose horny ring shows an early stage of hook formation (fig. 4). The hook becomes gradually more prominent (fig. 5), and is best marked in the sixth and seventh rows, where they have the form shown in the drawings (figs. 6, 7). The muscular part entirely covers the horny part of the hook in all those specimens, even the point being protected by a sort of membranous hood (fig. 7), but by mounting in Canada balsam they become quite transparent, and the outline of the hook itself shows clearly through.

There are about eight rows of hooks, beyond which the club bears three (or four?) irregular rows of minute suckers (fig. 3), whose horny ring bears five long acute teeth. The large marginal suckers (fig. 2), have four or five long pointed teeth, and a papillary area with two rows of spinous papillæ. In the specimen figured the flexible floor of the sucker intrudes very far into its cavity.

Subfamily GONATIDÆ, nov.

Gonatus, Gray, 1879.

Sepia loligo, Fabricius.
Onychoteuthis, Lichtenstein, Møller, Middendorff.
Owenia, Prosch (*pars*).
Lestoteuthis, Verrill (*pars*).
Cheloteuthis, Verrill.

Gonatus fabricii (Lichtenstein), Steenstrup.

1780. *Sepia loligo*, Fabr., Faun. grœnl., p. 358.
1818. *Onychoteuthis fabricii*, Licht., Sepien mit Krallen, p. 13.
1842. „ „ Møller, Ind. Moll. grœnl., p. 3.
1842. „ (*?*) *amœna*, Møller, *Ibid.*, p. 3.
1849. „ *kamtschatica*, Middff., Mém. Acad. Sci. St. Petersb., sér. 6, t. vi. p. 515, pl. xii. figs. 1–6.
1849. *Gonatus amœna*, Gray, B.M.C., p. 68.
1858. *Gonatus amœna*, Adams, Gen. Rec. Moll., p. 36, pl. iv. fig. 2.
1876. *Leachia borealis*, Jeffreys, Proc. Roy. Soc. Lond., vol. xxv. p. 180 (*err.*).
1876. „ *hyperborea*, Jeffreys, *Ibid.*, p. 193 (*pars*).
1878. *Gonatus amœnus*, Sars, Moll. Reg. Arct. Norv., p. 336, tab. xxxi.
1880. *Lestoteuthis kamtschatica*, Vll., Ceph. N. E. Amer., p. 251.
1880. *Gonatus fabricii*, Stp., Sthenoteuthis og Lestoteuthis, p. 9, pl. i.
1881. „ „ Vll., Ceph. N. E. Amer., p. 291, pl. xlv. figs. 1, 2.
1881. *Cheloteuthis rapax*, Vll., *Ibid.*, p. 293, pl. xlix. fig. 1.
1881. *Lestoteuthis fabricii*, Vll., *Ibid.*, pp. 387–393, pl. xlv. figs. 1, 2; pl. xlix. fig. 1; pl. lv. fig. 1.
1882. *Gonatus fabricii*, Stp., Notæ Teuthol. I., p. 143.

Habitat.—Lat. 58° 45′ N., long. 48° 39′ W., August 15, 1875. Taken by the tow-net during the cruise of H.M.S. "Valorous." Two young specimens.

Lat. 59° 16′ N., long. 37° 16′ W. Washed on board H.M.S. "Valorous" during a gale.[1]

Whole of Davies Strait, south and east of Greenland, lat. 58° to 61° N., long. 16° 52′ W.; Iceland; Færös, Atlantic, deep water; Mediterranean; South of Cape of Good Hope, lat. 40° S., long. 15° 18′ E. (Steenstrup); Porsangerfjord, Norway; Coast of Finmark, Norway (Sars); Kamtschatka (Middendorff); Japan (Steenstrup, Leiden Museum); Seal Island, Nova Scotia, from the stomach of a cod (Verrill); one hundred miles south of Newport, R.I., from the stomach of a fish (Verrill).

This remarkable form has received perhaps more maltreatment at the hands of teuthologists than any other of its class, as will appear from the above extensive synonymy. The most complete and reliable information we possess regarding it is in Professor Steenstrup's papers, but as these have by no means received the attention they deserved, owing probably to their having appeared in the Danish language, I shall make no apology for reproducing considerable portions of them here.

The genus *Gonatus* is defined as differing from all others of the same group in the following characters:[2]—

[1] This is the specimen alluded to by Dr. Gwyn Jeffreys in the "Valorous" Report (*loc. cit. supra*); he is mistaken, however, in stating that it was the same species as that obtained during the first cruise of H.M.S. "Porcupine," that being *Taonius hyperboreus* (see p. 191). The label on the bottle bears the name "*Leachia ellipsoptera*," written in pencil and almost erased.

[2] Sthenoteuthis og Lestoteuthis, p. 10.

1. *The Arms* have each four series of suckers or hooks, whilst all other Œgopsids have only two.
2. *The Ventral Arms* possess only suckers in all the four series, whilst the other arms have two series of suckers along the margins, and two series of hooks up the centre; a variation in the armature which is hitherto known in no other Enoploteûthid nor indeed in any Onychian at all.
3. *The Tentacles* are furnished even from a point low down upon the stem with regularly disposed longitudinal series of small suckers and corresponding fixing-cushions, which allow of the tentacles being attached throughout almost their whole length, an arrangement seen in no other Onychian.
4. *The Connective Apparatus* is continued up one side of the club, where it forms a group of five or six large suckers and fixing cushions, whilst the middle of the club itself is occupied by a very short series of two large and three very small hooks, and the elongated tip of the club is covered with small suckers. The club itself has no connective apparatus such as is seen in most Onychians.
5. *The Gladius* is narrow and linear anteriorly, but broader and lanceolate in the hinder two-thirds, whilst it ends posteriorly in a hollow cup or cone, which has several diaphragms within it, and is not covered outside and behind by a solid chitinous spine as is the case with most, perhaps all, Onychoteuthids and Enoploteuthids; at all events no species hitherto known has such a hollow cone.
6. *The Fins* reach some distance beyond the hinder end of the body, and their firm saddle-shaped cartilage slides upon the terminal portion of the gladius.
7. *The Radula* has only five rows of teeth, instead of the usual seven.

Such a combination of characters renders the creature easy to distinguish from all other forms, but if one of them be overlooked, as may readily happen on superficial examination, misunderstandings regarding it are sure to arise, and this has continually happened during the history of the species. For instance, Møller[1] failed to recognise his specimens of *Onychoteuthis* (*?*) *amœna*, some two inches long, as the young of the *Sepia loligo* of Fabricius,[2] which were two or three times as large.

The latter author gave a very accurate description of the species, and it is greatly to be regretted that he did not take an opportunity of comparing it with a specimen of the true *Sepia loligo*, Linn., for he would at once have recognised its distinctness and have given it a name which would have obtained currency; one consolation in this regard must be the fact that Lichtenstein gave the form its discoverer's name, which it still bears.

Gray received some specimens of this type from Møller and founded upon them the

[1] Ind. Moll. grœnl., p. 3.

[2] Faun. grœnl., p. 358.

genus *Gonatus*, not, however, without making several mistakes, which have since led to great confusion. Steenstrup has tabulated the most serious of these as follows:—

a. Gray overlooked the difference between the armature of the ventral and of the other arms, not seeing the tips of the hooks in the two median series of suckers, as his description "all with small circular rings"[1] proves; the same error reappears in the phrase "and the outer series of the cups on the shorter arms are like the other, with circular arms and no hooks."[2] Møller had rightly observed that the horny rings had often a very small hook on the margin, but thought, wrongly, that they had fallen out or were lost in those cases in which he did not see them ("uncinis marginalibus minutissimis et admodum caducis [rarissime obviis] instructis").[3]

b. Gray denied the presence of the minute suckers along the stems of the tentacles which Møller had correctly observed and recorded ("brachiis pedunculatis per totam longitudinem cotylis præditis"), whilst Gray in his turn perceived the hooks in the tentacular clubs whose existence Møller regarded as doubtful. ("Uncinos in brachiis ped. nondum vidi; fortasse tamen adsunt, sed æque caduci ac uncini brachiorum sessilium.")

c. Gray states that the siphon has "no interior valve," and that it is "without superior central band"; and

d. That the gladius has no terminal cup, although in other respects his description of it is correct.

Nothing was added to our knowledge of this form between 1849 and 1878, when Professor G. O. Sars published[4] some figures and a description of a small specimen captured in the Porsangerfjord, concerning which Steenstrup makes the following criticisms:[5]—

"In the enlarged details of portions of an arm, and of suckers from the median and lateral series, any one who is acquainted with *Gonatus* will readily recognise its characters, and will also see in fig. 10 an approximate though not quite accurate representation of its tentacles. The same holds of fig. 11, which represents the most important middle portion of a tentacular club, except that the connective apparatus is omitted both in the drawing[6] and in the text. As regards the gladius, the ventral aspect of which is shown in fig. 4, its terminal cone has been laid open in the middle line and spread out on either side, instead of being retained in its proper conical shape with which agrees also the expression in the text 'extremitate postico leviter cochleariformi.'

[1] B. M. C., p. 67. [2] *Op. cit.*, p. 68. [3] Ind. Moll. grœnl., p. 3.
[4] Moll. Reg. Arct. Norv., p. 336, tab. xxxi. [5] *Op. cit.*, p. 14.
[6] There are a number of minute dots along the arm which seem to me as though intended to suggest the presence of minute suckers.—W. E. H.

"The additions which must be made to Sars' description are in the direction of further detail, for the expressions used in characterising the structure of the arms and tentacles of this remarkable form are too general and undecided. It is not mentioned that the median suckers on three pairs of arms bear true hooks, nor that in this respect the ventral arms differ from the others, nor that the tentacles are provided with a connective apparatus both on the stem and on the club. Nevertheless, figs. 10, 11 leave no doubt that they were drawings from a *Gonatus* whose characters were not sharply perceived, while fig. 5, part of an arm with its four series of suckers, figs. 6, 7, 8, a sucker from the middle, and fig. 9, one from the lateral series, show clearly that there were two series of hooks and two of true suckers."

In 1880, Professor Verrill,[1] misled no doubt by Gray's errors and Sars' omissions, made *Onychoteuthis kamtschatica*, Middendorff, the type of a separate genus under the name *Lestoteuthis*, without recognising its identity with *Gonatus*, including also in it Dall's *Onychoteuthis robusta* (since made the type of a genus *Moroteuthis*, and since shown by Steenstrup to belong to *Ancistroteuthis*). Verrill's paper was followed by that of Steenstrup,[2] from which the above quotations have been made, but whilst it was passing through the press Verrill published the second part of his monograph,[3] in which he described a specimen of *Gonatus fabricii*, taken from the stomach of a cod, but still without recognising it as identical with *Onychoteuthis kamtschatica*, Middendorff (his *Lestoteuthis*), and in his Report on the "Blake" Cephalopods, 1881, published the genus *Cheloteuthis*, which, however, he speedily abandoned as synonymous with *Lestoteuthis*.[4]

In the appendix to his Monograph,[5] Verrill introduces another Cephalopod from Cumberland Gulf, which is said to have "four rows of true suckers on all the arms, and no hooks." This he is disposed, still misled by Gray's inaccurate description, to regard as doubtless "the *real Gonatus amœnus*, Gray." Steenstrup in a second paper[6] has pointed out the untenability of this view, and having recently examined Gray's types of *Gonatus amœnus* in the British Museum, I can quite corroborate all his statements regarding their absolute identity with *Gonatus fabricii*. What this Cumberland Gulf specimen really was has never transpired, as no further information about it has been published, but seeing the ease with which the hooks of *Gonatus* are overlooked, it is not impossible that it may also be referable to that genus.

Owenia, Prosch, which appears in the list of generic synonyms above, demands merely a few words of explanation; the Danish naturalist received along with his *Cranchia megalops* some small Cephalopods, which he wrongly regarded as being identical with it, and he was induced to separate his new species as a subgenus of *Cranchia* owing to the mantle not being directly continuous with the head dorsally, a character

[1] Ceph. N. E. Amer., p. 250.
[2] Sthenoteuthis og Lestoteuthis.
[3] Ceph. N. E. Amer., pp. 259–446.
[4] *Op. cit.*, p. 388.
[5] Notæ Teuthol., I.
[6] *Op. cit.*, p. 188.

found only in the wrongly identified specimens, which were afterwards shown by Steenstrup to be small specimens of *Gonatus fabricii*, so that the subgenus *Owenia* lost all *locus standi*.

The result of all this is a list of synonyms anything but pleasant to contemplate, but since the publication of the excellent plate in Steenstrup's first mentioned paper it will be difficult for any observer to mistake this form in the future.

The specimens which have come into my hands from the "Valorous" expedition are all small and have not enabled me to add anything of consequence to the descriptions which have gone before, but it appeared worth while to make their occurrence in the collection an opportunity for giving a resumé of the literature regarding this interesting form.

Family XII. TAONOTEUTHI, Steenstrup.

Subfamily CHIROTEUTHIDÆ, Gray.

Chiroteuthis, d'Orbigny.

Chiroteuthis (*?*), sp. (Pl. XXXI. figs. 1–5).

Habitat.—Pacific Ocean. Fragments of a gladius taken from the stomach of a shark, September 2, 1875.

One of the most curious specimens in the collection is this much damaged and fragmentary pen, for if I am correct in referring it to *Chiroteuthis*, that genus must attain dimensions which have been hitherto quite unsuspected.

The portions preserved are ten in number, of which three are mere scraps and give no information regarding the form of the complete structure. The largest piece is 22·5 cm. in length; with a maximum and minimum depth of 2 cm. and 1·5 cm. respectively, while the breadth varies from 0·85 to 1 cm. The form of its section at the larger and presumably the anterior end is shown in fig. 3: it is in fact a lamella, thickest in the mid-dorsal line where it is sharply folded to form a keel, thence it passes in two curves (like ∾) outwards, then downwards, and finally inwards towards the median line again. Whether the margins of the lamellæ were fused at this point, as will be seen to be the case in the posterior portion, cannot now be decided, but as in the majority of pens the anterior portion is flat and open, there is no reason for doubting that this was the portion where the opening began to take place.

The smaller extremity of the fragment in question has a section of the form shown in fig. 4, which was drawn, however, from a portion situated slightly farther back; it closely

resembles the other end, but the lamina is here thicker, and the ventral margins have fused, forming a closed quadrangular tube.

The next portion is quite similar in form, and from a consideration of its breadth and depth must have been situated posteriorly to the largest piece, and separated from it by a distance of 2 or 3 cm.; it measures 5 cm. in length. The next piece is 6·5 cm. long, and evidently fitted closely to the one just mentioned; this appears to have been followed by a piece 6 cm. long, separated from it by about 1 cm., and finally there is a portion 8·5 cm. long succeeding to this, but separated from it by about 5 cm. All these portions resemble the first in the form of their transverse section, and taper gradually backwards, so that the posterior extremity of the last has a depth of 6 mm. and a breadth of 4·5 mm., as shown in fig. 5. This termination is, however, roughly truncated, and was evidently not the end in the natural condition; it probably came to a point as in most other forms.

In addition to all these there is a long strip 26·5 cm. in length which consists almost entirely of the dorsal keel, which is here larger than in the portion first mentioned, and it is slightly larger at one extremity than the other. The smaller end was presumably separated by an interspace of unknown length, from the part shown in fig. 1, and on one side it bears a piece of the lamina, 6 cm. in length, 2·5 cm. in breadth posteriorly, and tapering to a point anteriorly (see fig. 2); the margin is perfectly smooth and even, so that this was evidently the anterior part of the expanded lamina or blade of the pen.

The anterior extremity of the keel (fig. 4*a*) is 5 mm. high, 3 mm. broad at the top, and 6 mm. at the base; it is irregularly truncated, so that it evidently did not form the anterior extremity, and its lateral margins are also rough, so that its breadth was originally somewhat greater than at present.

Unfortunately it is impossible to give even a probable estimate of the total length of the pen; all the fragments and the interspaces which can be calculated with some degree of certainty amount together to 78 cm., so that we have here a minimum; but what was the length of the flat expanded portion of the blade, or whether indeed any portion was actually widely spread out, there are no means of ascertaining.

The only structure known to me with which this pen can be at all compared is that of *Chiroteuthis lacertosa*, as described by Verrill, but to this the resemblance is apparently rather close. In both there is a narrow anterior portion, with a keel of very similar form (compare his figure, pl. lvi. fig. 1*a'* with Pl. XXXI. fig. 4*a*). The correspondence between his figure 1*a''* and fig. 3 is so close as to strike any one who places them side by side. The likeness is, I think, sufficient to prove that the forms belong at any rate to closely allied genera.

Professor Steenstrup has also told me that the specimen of *Doratopsis vermicularis*, in the Copenhagen Museum, has a pen somewhat resembling this, but as I did not see that specimen during my visit I can give no particulars regarding the comparison; it will be described and figured, however, in one of his forthcoming papers.

Histiopsis,[1] Hoyle.

Body resembling *Calliteuthis*, Verrill, in shape and in the pigment spots scattered over it. *Siphon* with a suspensory ligament and a valve.

Head large and broad; *eyes* very large.

Arms webbed to some extent between the dorsal, dorso-lateral, and lateral pairs. *Suckers* small in two series.

Tentacles truncated in the only known specimen.

Gladius resembing that of *Loligo*, but short and broad.

This genus is erected for a unique specimen which was brought up by the trawl in the middle of the South Atlantic; as will appear in the sequel it presents characters which show it to occupy a position intermediate between *Calliteuthis* and *Histioteuthis*.

Histiopsis atlantica, Hoyle (Pl. XXX. figs. 9–15).

1885. *Histiopsis atlantica*, Hoyle, in Narr. Chall. Exp., vol. i. p. 273 (*nomen tantum*).
1885. „ „ Hoyle, Diagnoses II., p. 201.
1885. „ „ Hoyle, Prelim. Rep. II., p. 306.

Habitat.—Station 333, Mid-South Atlantic, March 13, 1876; lat. 35° 36′ S., long. 21° 12′ W.; 2025 fathoms; Globigerina ooze. One specimen, ♂.

The Body is short and conical; acuminate and curving gently downwards posteriorly. The *fin* is about one-third the length of the body and considerably broader than long; each half is roughly semicircular and narrows into its insertion both in front and behind. The *mantle-margin* is in general transverse, but projects slightly as a blunt rounded angle in the dorsal median line. The *mantle-connective* consists of a groove with a narrow median fillet in the mid-dorsal line fitting into a corresponding cartilaginous surface on the back of the neck, and of a long linear ridge extending up to the margin, which fits into a shorter groove on the base of the *siphon;* this is broad, short, and conical, has a thick suspensory ligament, through the skin of which two muscles may be distinguished, and a distinct valve.

The Head is as large as the body, rounded at the sides, and flattened above and below. The *eyes* appear to have been enormous, one is distended and protrudes from its orbit, whilst the other is shrivelled (fig. 9). There is no auricular crest nor preocular pore, but behind each eye is a white papilla.

The Arms are about equal in length to the head and body together; the dorsal are

[1] Contracted from "*Histioteuthopsis*." There being only one species the generic diagnosis is of course merely provisional.

the shortest, the other three pairs subequal, the order of length being 3, 4, 2, 1; they are quadrilateral, with rounded angles externally, with two slightly raised ridges internally, on which the suckers are situated; they taper gradually to very slender tips; the third pair have a delicate narrow web along the third quarter of their outer aspect. The *suckers* are in two series throughout; they are small and distant along the proximal third (the webbed portion) of the arms, then larger and closer, and finally minute and very closely set towards the tips; they are set transversely on short conical peduncles, spheroidal, with a swollen band round the face. The *horny ring* (figs. 12, 13) is smooth proximally, distally it bears about five close-set, broad, bluntly rounded teeth; the smaller proximal suckers have a smooth ring (fig. 14). No trace of *hectocotylisation* could be found on any of the arms. The *umbrella* is found only between the dorsal, dorso-lateral, and lateral arms; it takes origin from the sucker-bearing ridge and extends about one-third up the arm. The *buccal membrane* (fig. 11) is broad and somewhat contracted over the mouth; it has the usual seven points, but they are very blunt and indistinct; it is united by three ligaments with the web between the dorsal and dorso-lateral arms, by a ligament with the inner side of each ventro-lateral arm on its ventral aspect, and by another to the inner surface of each ventral arm, there being altogether seven ligaments. The membrane bears no suckers; its inner surface is much creased and folded. The *outer lip* is very thin and smooth, and hidden between the creased integument of the buccal membrane and the *inner lip*, which is thick and marked with irregular radial grooves.

The Tentacles have been removed; the stumps which remain are not half the length of the arms; they are quadrangular and flattened from above downwards.

The Surface bears a large number of papillæ, slightly elevated, resembling those of *Calliteuthis;* they are arranged most thickly on the ventral aspect of the head and body, but there are also a few on the dorsal surface; they extend up the outer aspect of the arms, three series on the ventral arms, two on each of the others. Near the tip of each dorsal arm is a series of four or five black, elongate, egg-shaped swellings, gradually diminishing in size, and forming apparently an extreme development of the papillæ above mentioned. The second pair of arms appears to have been similarly provided; the third has been so stripped of integument towards the tips that it is impossible to ascertain the original condition. In the fourth the warts at the tip are quite similar to those lower down the arm.

The Colour is a dull purplish-madder, paler above than below, the papillæ are a deep black, with a white centre, usually situated towards the anterior margin. The *buccal membrane*, both sides of the umbrella, and the inner surfaces of the arms, so far as this extends, are a deep purple.

The Gladius (fig. 15) resembles that of *Loligo*, the anterior portion forming about one-fourth the total length.

Dimensions.

Length, total,	96 mm.
End of body to mantle-margin, ventrally,	25 „
End of body to mantle-margin, dorsally,	35 „
End of body to eye,	40 „
Breadth of body,	22 „
Breadth of head,	22 (?) „
Eye to edge of umbrella,	12 „
Length of fin,	15 „
Breadth of fin,	21 „
Diameter of largest sucker on sessile arm,	1 „
Diameter of eye,	15 „
Diameter of lens,	7 „

	Right.	Left.
Length of first arm,[1]	45 mm.	47 mm.
Length of second arm,	51 „	56 „
Length of third arm,	55 „	55 „
Length of fourth arm,	50 „	50 „

This form is evidently related both to *Histioteuthis* and to *Calliteuthis*, and in many respects is intermediate between them. For instance, while *Histioteuthis* has a large web, and *Calliteuthis* none, *Histiopsis* has a web which reaches about halfway up the arms. The dorsal bands of the siphon are present in *Histioteuthis*, present in *Calliteuthis*, whilst in *Histiopsis* they are present but concealed, and not obvious except on close examination.

As regards the presence of a valve in the siphon of these forms there seems to be some uncertainty; d'Orbigny[2] united the genera *Loligopsis*, *Chiroteuthis*, and *Histioteuthis* in the family Loligopsidæ, which had, amongst other characters, that of being destitute of a siphonal valve. The first of these genera, as has been already pointed out (p. 46), has no systematic *locus standi* whatever; *Histioteuthis* is usually described as having no valve, as is also *Chiroteuthis* by Vérany,[3] d'Orbigny and Brock,[4] whilst Verrill in a species described by him from the North Atlantic, which certainly seems to belong to this genus, distinctly affirms that a valve is present. Professor Lankester informs me that in a *Chiroteuthis veranyi* in University College Museum, London, "there is a very small, in fact, a rudimentary valve, just a transverse fold not projecting much" and also that he has acquired a *Histioteuthis* with a "well-developed valve in its funnel." From this it seems certain either that an error has been made by some observer or else that one species of *Chiroteuthis* has a siphonal valve, whilst others have not, which would imply that the systematic value of this structure is very much less than has hitherto been supposed, for its presence or absence has generally been considered as

[1] Measured from the centre of the eye.
[2] Céph. acét., p. 320.
[3] Céph. médit., p. 120.
[4] Morphol. Jahrb., Bd. vi. p. 261, 1880.

constant within the limits of the same family. Perhaps the readiest explanation is that the valve being very small, Vérany and others have overlooked it in *Chiroteuthis;* but it seems at present impossible to explain the discrepancy regarding *Histioteuthis.*

It seems advisable provisionally to rank the present form in the same family with *Calliteuthis* and *Histioteuthis,* to which it is certainly allied, under the name Chiroteuthidæ, Gray; which will be equivalent to d'Orbigny's Loligopsidæ without its type-genus, and which seems to be uncertain in respect of the presence of a siphonal valve.

Verrill has proposed [1] a new family, Histioteuthidæ, but in our present lack of knowledge on many points connected with these interesting forms the step seems to me hardly justified, especially in view of the existence of a genus so clearly intermediate between the two principal genera as the present.

Calliteuthis, Verrill.

Loligopsis, Owen (*pars*).

Calliteuthis reversa, Verrill (Pl. XXXIII. figs. 12–15).

1880. *Calliteuthis reversa,* Vll., Amer. Journ. Sci. and Arts, vol. xx. p. 393.
1881. „ „ Vll., Ceph. N. E. Amer., p. 295, pl. xlvi. fig. 1.
1884. „ „ Vll., Second Catal., p. 243.

Habitat.—Station 168, east of the North Island, New Zealand, July 8, 1874; lat. 40° 28′ S., long. 177° 43′ E.; 1100 fathoms; blue mud. One immature specimen taken at the surface.

Station 232.—The *Hyalonema* ground off Ino Sima Island, Japan, May 12, 1875; lat. 35° 11′ N., long. 139° 28′ E.; 345 fathoms; green mud. One specimen.

Several stations off the eastern United States, depths 1000 to 3000 fathoms (Verrill).

Verrill's admirable description and figures leave no room for doubt as to the identity of the Challenger specimen with his species. The temptation is great to regard it as also synonymous with Sir Richard Owen's *Loligopsis ocellata,*[2] the more so as this is from the China Sea, while the Challenger individual was taken near Japan. The only differences which I can discover on a careful perusal of his diagnosis are, firstly, the form of the fin, which does not extend posteriorly beyond the extremity of the body; secondly, the smaller relative size of the suckers, and thirdly, the fact that the horny rings of these are extremely prominent and toothed.

The mantle-connective is a little more complicated than Verrill's description would indicate; the sockets on the base of the funnel are pyriform hollows, the deeper portion being posterior; the ridge on the mantle itself is divided into two portions, of which the posterior is much the more prominent, and separated by a distinct gap from the anterior, which is low and narrow.

[1] Ceph. N.E. Amer., p. 431.

[2] *Trans. Zool. Soc. Lond.,* vol. xi, p. 139.

The tentacular arm has been described but not figured by Verrill, a drawing of it is therefore appended here (figs. 12–14); the central series of suckers should have been represented as somewhat larger than the others as indicated by Verrill.

The pen (fig. 15) has a short, narrow, anterior extremity expanding into a subcaudate blade, posteriorly it curves round the hinder end of the viscera, and then is reflected as a very thin, irregular, membranous expansion.

The fact that the same species (or at all events two closely allied species) is found both in the Western Pacific and in the Western Atlantic is of great interest, and especially when considered in relation with the similar distribution of *Octopus januarii*, *Eledone verrucosa*, *Eledonella pygmæa*, and *Eledonella diaphana*.

The identification of the small specimen from New Zealand is uncertain.

Family XIII. Cranchiæformes, Steenstrup.

Subfamily Cranchiadæ, Gray.

Cranchia, Leach.

Cranchia (*Liocranchia*) *reinhardtii*, Steenstrup (Pl. XXXI. figs. 11–14; Pl. XXXII. figs. 1–4).

1857. *Leachia Reinhardtii*, Stp., Hectocotyldannelsen, p. 200.
1861. *Cranchia Reinhardtii*, Stp., Overblik, p. 76.
1879. *Loligopsis Reinhardtii*, Tryon, Man. Conch., vol. i. p. 165.
(*nec.*) 1882. *Cranchia Reinhardtii*, Brock, Zeitschr. f. wiss. Zool., Bd. xxxvi. p. 605.
1884. *Perotis Reinhardtii*, Rochebr., Monogr. Loligops., p. 25.
(*nec.*) 1884. *Cranchia cf. Reinhardtii*, Pfr., Ceph. Hamb. Mus., p. 29.

Habitat.—Station 106, August 25, 1873; lat. 1° 47′ N., long. 24° 26′ W.; depth, 1850 fathoms. Two young specimens, in all probability from the surface.

North Atlantic, lat. 15° to 28° N., long. 18° to 32° W. (Steenstrup); within the Tropics, longitude of the Azores (Kiel Museum, *fide* Steenstrup).

The Body (fig. 4) is rotund and barrel-shaped, the diameter being greater than half the length, bluntly rounded behind; a little in advance of the posterior extremity on the dorsal surface is a process containing the end of the pen (figs. 2, 3), to it are attached the *fins* for about half their length. They are subquadrate, the posterior angles being better marked than the anterior; they are attached by their inner margins, for the anterior moiety to the process of the body above mentioned, for the posterior to each other. The *mantle-margin* passes anteriorly in even curves from one point of attachment to another. From the point of attachment at either side of the funnel,

which is indicated by a cartilage-like speck in the body wall, there extend backwards two cartilage-like lines (fig. 11), diverging at an angle of some 60°, each of which bears about thirteen minute pointed papillæ; a similar row stands upon the tissue covering the gladius in the middle of the back. The *siphon* is short, bluntly conical, and usually projects only very little above the margin of the mantle.

The Head is very short but broad; the *eyes* are prominent and the lens protrudes from the larger portion of the organ; behind the eye is a papilla, and in front of and below it are several minute, white, spherical bodies (fig. 1), which in many cases are embedded in a prominent, irregularly-shaped mass of tissue.

The Arms (fig. 1) are short and very unequal, their order of length being 3, 4, 2, 1 (in some specimens 4 and 2 are almost equal); the third pair being twice as long as the second and three times as long as the first. Each arm bears two rows of minute pedunculate *suckers* (fig. 13), which have smooth horny rings. The *umbrella* extends halfway up the dorsal arms, and is of about the same breadth between them and the second and between these and the third, while it is absent between the ventral arms and between them and the third pair. The *buccal membrane* has five points, below it passes into two fillets which run side by side, separated by a narrow groove, to join the ventral arms (fig. 1). The *outer lip* is thin; the *inner* thick and rounded, both being smooth.

The Tentacles (fig. 12) are comparatively stout, twice as thick as the sessile arms, very slightly thickened towards the club, and then tapering to exceedingly fine points. The *club* has a very narrow delicate web up either side, and bears four rows of pedunculate *suckers* (fig. 14). These are rather larger at the middle of the club than at either end, and those of the two median series are slightly larger than the lateral ones; at the tip they are exceedingly minute; and two series of very small ones commence about half way up the stem and continue up to the club. They are spheroidal in form and oblique, with a small aperture, and a smooth *horny ring*, surrounded by long, narrow, radially disposed papillæ, from which radial grooves pass towards the margin.

The Colour (in the spirit specimens) is pale, almost white, semitransparent.

The Surface is smooth but for the papillæ above described.

The Gladius is as long as the mantle, very narrow, and slightly expanded behind into a lanceolate extremity.

The above description has been drawn up from specimens kindly lent to me by Professor Steenstrup; those obtained by the Challenger were young, only 7 to 8 mm. long in the body, and at first glance not at all unlike the figures of *Cranchia megalops*, Prosch,[1] and although I have no hesitation in referring them to *Cranchia reinhardtii*, they present many interesting differences from the more developed forms. The fins are smaller comparatively, the arms are shorter and have very few suckers, the dorsal arms

[1] Nogle nye Cephalopoder, figs. 4, 5, 6.

are represented only by papillæ, each bearing two suckers; the second pair are larger than the third and bear five suckers, while each ventral arm is indicated only by one very minute sessile sucker.

On the tentacles the suckers commence close to the base instead of half way up the stem, whence one would be disposed to infer that the growth of these organs takes place at the base rather than the apex. The club is not in the least expanded, and four rows of suckers are found only at the extreme tip. Below and in front of the eye are two or three minute white shining dots but no swollen mass of tissue. The usual four cartilage-like bands pass down the ventral surface, but the number of papillæ is less than in the adults, being only from seven to nine.

I am unable to refer to this species *Cranchia reinhardtii*, Brock,[1] and *Cranchia cf. reinhardtii*, Pfeffer.[2] The former differs so conspicuously in the form of the body, which indeed is more like that found in *Taonius* than that characteristic of *Cranchia*. It must be remembered, however, that the correct pictorial reproduction of the form of these specimens requires great care for its accomplishment. I distended the mantle-cavity of several specimens by means of a syringe, and only one of them (fig. 4) showed any conical process at the posterior extremity whatever, and that was very different from the form given in Brock's figure. This same specimen had, however, a number of spots, of which several situated on the ventral surface and on one fin are shown; they were not darkly pigmented, but pale, like the rest of the body, from which they seemed to differ in structure rather than colour; a few very faint markings could also be deciphered on the tentacles; there seemed, however, to be no other points indicating that this form was distinct from the others. It would be interesting should there be proved to exist a series of forms with more or less elongated bodies connecting *Cranchia* with *Taonius*.

Dr. Pfeffer's species, with regard to the position of which he expresses great doubt, does not appear to me to be *Cranchia reinhardtii*, Steenstrup; its body-form is quite different, resembling that of Brock's specimen, the web between the arms is present between the third and fourth pairs; the arms are compressed and the third and fourth provided with a fin, the tentacles have two ridges separated by a furrow, one of which expands into a web, and there are other smaller differences which a comparison of the descriptions will disclose.

Whether Pfeffer's specimen belongs to the same species as Brock's, I have of course no better means of ascertaining than had he.

Brock (*loc. cit.*) suggests on the basis of the specimen figured by him that *Cranchia reinhardtii* may be the same as *Cranchia maculata*, Leach; and as I have recently been able to examine the type of that species in the British Museum, it may be well to give some account of it here.

[1] *Zeitschr. f. wiss. Zool.*, Bd. xxxvi. p. 605, pl. xxxvii. fig. 4, 1882.
[2] Ceph. Hamb. Mus., p. 29, fig. 35.

The Mantle is so crumpled that it is almost impossible to ascertain its original outline, but it seems to have been rather elongated for a *Cranchia*, but not so long as a *Taonius*. It is fused with the head in the middle line dorsally, and also on each side in a minute cartilaginous patch with the base of the *siphon*, which is short and conical. The mantle has no tubercles, but is covered with oval black specks about 2 mm. apart. The *pen* forms a thin cartilaginous line down the back, and is very slightly expanded posteriorly. The *head* and *arms* are entirely wanting. The length is about 3 cm., the breadth 1 cm. It is readily distinguishable from Brock's form by the absence of tubercles on the mantle, and approaches more than any other form with which I am acquainted Dr. Pfeffer's *Megalocranchia*, which, however, there can be little doubt is based upon a small *Taonius*.

Cranchia sp.

Habitat.—Surface between the Cape and Marion Island. One young specimen mounted in Canada balsam.

About this portion of the cruise, Dr. v. Willemoes-Suhm notes in his diary that a few specimens of *Cranchia* were taken in every haul of the tow-net, but this is the only one that has come into my hands from this region.

Each sessile arm has only one sucker, except the ventral, which have two; the horny ring of the suckers seems to have no teeth, but is surrounded by papillæ. The tentacles have suckers with smooth rings, surrounded by two rows of papillæ, a point in which they differ from those of *Cranchia reinhardtii*, and some of them seem to have a fringe round the margin. The pen is not visible.

Taonius, Steenstrup.

Loligopsis (pars), d'Orbigny, Tryon, de Rochebrune, &c.
Desmoteuthis, Verrill.
Procalistes, Lankester.
Phasmatopsis, de Rochebrune.
Megalocranchia (?), Pfeffer.

Body elongated, semitransparent, head comparatively small, eyes prominent, sometimes very large. Mantle united with the back of the head by a firm band, which widens posteriorly, the surface of the back either directly continuous with that of the head, or marked off, if at all, by an exceedingly slight fold. Mantle also connected with the body at either side of the base of the funnel. Funnel devoid of a valve, but possessing Verrill's organ.[1] Fins meeting at the posterior end of the body usually in a point.

[1] By this name I denote an apparatus which has been found in every species of *Taonius* examined by me, except *Taonius cymoctypus*. It consists of two pads within the funnel near its base, and a little posterior to them in the middle line one or two tubercles. It is figured by Verrill, who first noticed it, in his *Desmoteuthis tenera* (Ceph. N. E. Amer., pl. lv. fig. 2*d*).

Arms short compared with the body, furnished with two rows of globular suckers.

Tentacles present, and bearing four rows of suckers on the distal extremity (*Taonius pavo*, doubtful as regards the last point, owing to mutilation).

Gladius long and narrow, somewhat expanded towards the fins and forming a hollow pointed cone behind.

The genus *Taonius* was established by Steenstrup in 1861 to include *Loligo pavo*, Lesueur, and *Taonius hyperboreus*, and since his description has been overlooked by most subsequent writers it may not be out of place to translate some parts of it.

In the first place, the whole family Cranchiæformes is characterised thus: "The mantle is firmly united with the head at three separate points—namely, directly in the dorsal median line, and indirectly by means of the funnel on either side of it, where there is usually a movable sliding cartilaginous articulation or hook in other Cephalopoda."[1] Then, under the heading *Taonius hyperboreus*, he adds: "As soon as the relations of the tentacles and the structure of the arms in the genus *Leachia* are carefully considered, it is obvious that *Loligopsis pavo*, Lesueur, and *Leachia hyperborea*, Steenstrup, which have hitherto been referred to it, must form a separate group. For in addition to the fact that the latter species has, and the former seems to have had, tentacles, both have narrow elongated fins, which extend along a large portion of the body, and are strikingly characterised by their enormous eyes, which almost meet on the ventral surface, and by a funnel, which is shorter and smaller than that of *Leachia*. The gladius agrees very well with that of other Cranchias, but may, on the whole, be described as expanded at the inferior extremity."

"The generic name *Taonius* is chosen more especially with reference to the longest known species, whose beautiful coloured spots suggested the specific name *pavo*; how far similar spots may have been present on the body of my species *hyperboreus*, I cannot say. . . . In case a division of the genus should become desirable, I regard the older species *Lol. pavo*, Les., as the type."

It appears from these passages that Steenstrup regarded *Loligo pavo*, Lesueur, as the type of his genus, and he did not consider it essential to make a long and detailed statement of its characters, because d'Orbigny had already done this when in 1839 he took Lesueur's *Loligo pavo*, named it *Loligopsis pavo*, and then proceeded to draw up a full generic diagnosis based upon this specimen and upon another (*Taonius cymoctypus*) which he erroneously regarded as belonging to the same species; in other words, Steenstrup's *Taonius* is practically identical with d'Orbigny's *Loligopsis*. It is of great importance that this should be clearly understood, because in 1882 Professor A. E. Verrill constituted[2] a new genus, *Desmoteuthis*, based upon a specimen captured near the

[1] Overblik, p. 70.

[2] Céph. N. E. Amer., p. 216.

northern edge of the Gulf Stream, which he erroneously regarded as identical with *Taonius hyperboreus*, Steenstrup. Another species, *Desmoteuthis tenera*, Verrill, which is almost certainly identical with the real *Taonius hyperboreus*,[1] has since been added to the genus.

The most striking character in the generic diagnosis of *Desmoteuthis* is "Anterior edge of the mantle united directly to the head, on the dorsal side, by a commissure, so that there is no free edge medially; . . . two additional muscular commissures unite the lateral inner surfaces of the mantle to the sides of the siphon." This may be compared with the first sentence translated above from Steenstrup, and with d'Orbigny's description of his genus *Loligopsis*,[2] in which occur the following words: "Appareil de résistance consistant en trois larges brides, ou attaches fixes, placés au bord même du corps, qui le lient intimement à la tête, l'une cervicale ou dorsale à l'extremité de la saillie médiane de la coquille. Les deux autres latérales inférieures au lieu ou est ordinairement l'appareil inférieur mobile." It seems almost impossible to resist the conclusion that he means hereby to describe a precisely similar structure; furthermore, in the drawing of his *Loligopsis pavo*,[3] the dorsal margin of the mantle is shown, extending on to the head behind the eye. The remainder of the definition of *Desmoteuthis* sounds almost like a translation of that of *Loligopsis*, and nowhere are they in contradiction, as any one may see who reads them side by side.

These quotations would probably suffice to show that *Desmoteuthis* must be regarded as a synonym of *Taonius*, but in addition I have recently had the opportunity of examining the following specimens belonging to this genus:—The type specimens of *Taonius pavo* and of *Taonius cymoctypus* in the Paris Museum, that of *Taonius hyperboreus* in the Copenhagen Museum, a somewhat mutilated specimen of the same species in the Challenger collection, and two from the "Porcupine" Expedition; a specimen of an unpublished species which Professor Steenstrup proposes to call *Taonius elongatus*[4] (Pl. XXVIII. fig. 13); and two specimens of *Taonius suhmi*, from the Challenger collection; and on the basis of this material the above description of the genus has been drawn up, which will, I think, leave no doubt as to its identity with *Desmoteuthis*. Not only is this the case, however, but it seems also most likely that the specimen which Verrill obtained from the northern edge of the Gulf Stream, and which he believed to be identical with *Taonius hyperboreus*, was none other than *Taonius pavo*.

That it differs from the former of these may be seen by a most cursory examination of the type specimen, or of Pl. XXXIII. fig. 1, and may be also seen by a careful comparison of Verrill's figures with Steenstrup's description.[5] *Taonius hyperboreus* is there defined

[1] *Op. cit.*, p. 412.

[2] Céph. acét., p. 320; Moll. viv., p. 368.

[3] Céph. acét. pl. iv. fig. 1; Moll. viv., pl. xxiii. fig. 6.

[4] *Taonius elongatus*, Stp., MS., is characterised by its elongated form, by the *body* being broadest anteriorly and tapering backwards at first rather suddenly, then more gradually. The *fin* is cordate and pointed behind like that of *Taonius suhmi* but much larger, and the *eyes* are comparatively small.

[5] Overblik, p. 84.

by its differences from *Taonius pavo*, viz.: "(1) the length and breadth of the fin, which is half the length of the body and six times as long as broad; (2) the large and almost regularly spherical suckers, which are several times larger than those of *Taonius pavo*, and especially on the lateral arms attain an astonishing size, so that the largest have a diameter as great as the breadth of the arm; and (3) the presence of a toothed marginal membrane along all the arms."

In every one of these characters it will be noticed that Professor Verrill's specimen differs from *Taonius hyperboreus*, and inclines rather to *Taonius pavo;* and further, a careful comparison of his figures and description with those of *Loligopsis pavo* (Lesueur), places it beyond all reasonable doubt that these are identical.

The general shape of the body is practically identical in the two forms, but the fin is produced in Verrill's drawing into "a long acute tip," which does not appear in Lesueur's, but which may very well have been present originally, for the posterior extremity of the type specimen has been injured.

In both specimens the arms are not complete, "except those of the third and fourth pairs, which are nearly equal in length, the ventral ones a little the shortest and most slender." In both specimens, too, "the arms are *all* united together by a thin, delicate basal web, which extends up some distance between the arms, . . . and then runs along the sides of the arms, as broad, thin, marginal membranes."

As regards the horny rings of the suckers, d'Orbigny figures two from the base of an arm which may have been taken from this species, and which have square-cut teeth somewhat variable in number. The sucker figured by Verrill from the middle of one of the lateral arms (third pair) resembles these very closely, and he adds that "toward the tips of the arms the smaller suckers again become deeper, with more contracted apertures, and with a few more prominent denticles on the rings;" but he does not allude to the conspicuously four-toothed suckers characteristic of *Taonius cymoctypus*, which he could not fail to have noticed had they been before him.

The general shape of the sucker, too, agrees fairly with that figured by Lesueur.

Verrill's account of the pen of his *Desmoteuthis hyperborea* describes that of *Loligopsis pavo* (Lesueur), very well, for the latter, like the former, terminates posteriorly in a hollow cone. This is not shown in Lesueur's drawing, though it is quite evident in the specimen; the drawing indeed is merely a sketch giving a general idea of the form of the pen, which has never been removed from the specimen.

The passages in quotation marks above are taken from Verrill's description, and when compared with d'Orbigny's figures, they leave, I think, little room for doubt that the two species in question are the same.

Taonius hyperboreus, Steenstrup (Pl. XXXII. fig. 12; Pl. XXXIII. figs. 1–11).

1856. *Leachia hyperborea*, Stp., Hectocotyl., p. 200.
1861. *Taonius hyperboreus*, Stp., Overblik., p. 83 (*non* Verrill).
1870. *Leachia ellipsoptera*, Carpenter, Jeffreys and Thomson, Proc. Roy. Soc. Lond., vol. xviii. p. 423.
1879. *Loligopsis hyperborea*, Tryon, Man. Conch., vol. i. p. 162.
1882. *Desmoteuthis tenera* (?), Vll., Ceph. N. E. Amer., p. 412, pl. lv. fig. 2; pl. lvi. fig. 3.
1884. *Taonius hyperboreus*, Vll., Second Catal., p. 245.
1884. *Loligopsis hyperborea*, Rochebr., Monogr. Loligopsidæ, p. 12.
1885. *Taonius hyperboreus*, Hoyle, Loligopsis, p. 321.

Habitat.—Station 50, South of Halifax, Nova Scotia, May 21, 1873; lat. 42° 8′ N., long. 63° 39′ W.; 1250 fathoms; blue mud. One specimen, ♂, probably from the surface.

North Atlantic, 140 miles north-west of the Irish Coast, July 2, 1869; lat. 56° 10′ N., long. 13° 16′ W.; surface ("Porcupine" Expedition). Two specimens.

North Greenland (Steenstrup). Off Martha's Vineyard, 87½ miles from Gray Head; 388 fathoms (?)[1]; two specimens. Off the New England Coast, lat. 39° 27′ 10″ N., long. 69° 56′ 20″ W.; 1346 fathoms (?)[1]; one specimen, Verrill.

The Body (fig. 1) is elongated, tapering posteriorly; the *mantle* is thin, enclosing an enormous branchial cavity, only a small portion of which is occupied by the viscera; its anterior border is transverse or projects slightly in the dorsal median line and at each lateral attachment; in the former of these positions the surface of the body is almost continuous with that of the head, only the very slightest fold of the mantle marking it off. The *fin* is about half the length of the body and of an elongated cordate shape, the form of the hinder margin being, however, slightly variable. The *siphon* is triangular, and reaches to about the centre of the head; on its dorsal wall, immediately behind the aperture, are two low cushion-like papillæ in the middle line, and behind these three long, pointed papillæ arranged in a triangle with the apex directed forwards.

The Head proper is small, much smaller than either of the enormous globular *eyes*, which occupy the whole of its two lateral surfaces.

The Arms are short, on an average about one-third the length of the body; their order of length is 3, 2, 1, 4; a toothed membrane extends along the arms, but forms only a very small web between them (fig. 12). They are furnished with two rows of suckers, most numerous and closely packed on the dorsal arms. The *suckers* (figs. 2–5) are subglobular, the proximal half of the globe being opaque and muscular, the distal corneous and semitransparent. The suckers on the dorsal and ventral arms are subequal; and also on the lateral arms for the proximal half of their length; on the third quarter are situated about eight large suckers, whose diameter fully equals that of

[1] The query is not intended to imply any doubt as to the accuracy of the observations, but merely as to whether the specimen was taken at the bottom.

the arms; on the terminal fourth the suckers gradually diminish. The margin of the larger suckers is almost entire but marked out into irregular very shallow, square-cut teeth (figs. 2, 3); on the distal margins of the smaller suckers the teeth become more prominent, but are blunt, and about eight to ten in number.

The Tentacles (fig. 6) are but little longer than the arms, and only slightly expanded at their extremities. On the inner side of the stem is a groove which bears two and afterwards four irregular rows of very minute suckers (fig. 7), among which are a number of fixing-cushions (fig. 10). On the *club* are four rows of suckers about as large as the smaller ones on the arms; their *horny rings* are provided on the proximal semicircumference with about fifteen closely set subacute teeth, while the distal semicircumference bears about nine long very acute teeth (fig. 8, 9).

The Surface is smooth.

The Colour is pale yellowish-grey; a number of purplish chromatophores cover the mantle, and there are also a number of larger spots disposed in irregular rows, of which there are about ten down the mantle.

The Gladius (fig. 11) is long, narrow anteriorly, expanded in the posterior half, and forming a hollow terminal cone enclosing part of the genital gland.

Taonius suhmi (Lankester), Hoyle (Pl. XXXII. figs. 5–11).

1884. *Procalistes Suhmii*, Lankester, Quart. Journ. Micr. Sci., N.S., vol. xxiv. p. 311, figs. 1, 2.
1885. *Taonius suhmii*, Hoyle, in Narr. Chall. Exp., p. 472, figs. 173, 174.

Habitat.—Station 159; Southern Ocean due south of Australia, March 10, 1874; lat. 47° 25′ S., long. 130° 22′ E.; 2150 fathoms. Surface (?) Two specimens.

Between Sydney and Wellington, June 16–17, 1874. Three young specimens mounted as microscopic objects, and one preserved in spirit. Surface.

North Atlantic, off the coast of Africa, April 13, 1876. Surface. One small specimen.

The Body is elongated and fusiform, broadest about one-third back, narrowing gradually forwards and tapering to an acuminate point behind. The *fin* is small, about one-eighth the length of the body, and cordate in form. The *mantle-margin* is directly transverse, and forms three watch-pocket-like openings between its dorsal and lateral attachments, and at each of the latter of these is an oblong semitransparent piece of cartilage-like material. The *siphon* is long, reaching as far as the bases of the arms, and tapering; it opens anteriorly by a transverse slit.

The Head is small and subquadrate, its anterior end being entirely occupied by the bases of the arms, and the hinder portion of its sides by the large pedunculate eyes (fig. 5).

The Arms are unequal, the order of length being 4, 3, 2, 1, and on an average

about one-fifth the length of the body; they are slender, tapering and rounded, and neither keeled nor webbed. The *suckers* are in two series, spheroidal, and provided with smooth horny rings (fig. 6).

The Tentacles (fig. 9) are about three-fourths as long as the body, slender, cylindrical, not expanded into a distinct club; the extremity bears four series of suckers, the marginal ones being a little smaller than the median. The *suckers* (fig. 7) are of quite normal shape, and the *horny ring* both of the median and marginal ones bears four strong bluntly pointed teeth (figs. 7, 8).

The Surface is smooth throughout.

The Colour is pale, almost white, and the mantle semitransparent even when preserved, no doubt quite so when living; a number of oblong chromatophores are arranged in about eight transverse rows (fig. 5).

The Gladius, so far as could be ascertained without extraction, does not differ materially from that of the other species of the genus.

Dimensions.

Length, total,	82 mm.
End of body to mantle-margin,	42 „
End of body to eye,	45 „
Breadth of body,	12·5 „
Breadth of head,	3 „
Breadth of head across the eyes,	11 „
Length of fin,	7 „
Breadth of fin,	4 „

	Right.	Left.
Length of first arm,	5 mm.	5 mm.
Length of second arm,	6 „	6 „
Length of third arm,	8 „	8 „
Length of fourth arm,	8·5 „	8·5 „
Length of tentacle,	33 „	37 „

The three small specimens taken in the Southern Ocean demand a careful discussion, inasmuch as they and the drawing by Dr. v. Willemoes-Suhm, reproduced in the accompanying woodcut (fig. 9), were made by Professor Lankester the basis of a new genus, *Procalistes*, characterised as follows:—"Similar to Cranchia, excepting that the eyes are pedunculate, that the shorter perioral arms are aborted, and that the longer (so-called prehensile) arms are devoid of suckers. In the youngest stage observed there are two rows of suckers on the long arms, and six isolated and pedunculated suckers surrounding the mouth, which appear to represent the shorter arms of other Cephalopods."

The capture of these individuals is thus alluded to in Dr. v. Willemoes-Suhm's MS. journal.

"16th June, 1874.—Among the surface gatherings there is a transparent and very interesting Pteropod, with large eyes on the tentacles and without any 'ptera' or foot. Having obtained three more or less damaged specimens from which I could not complete its anatomy, I shall have to defer giving a proper account of it. The animal belongs to the Clionidæ, and is probably allied to Pelagia, Quoy and Gaimard."

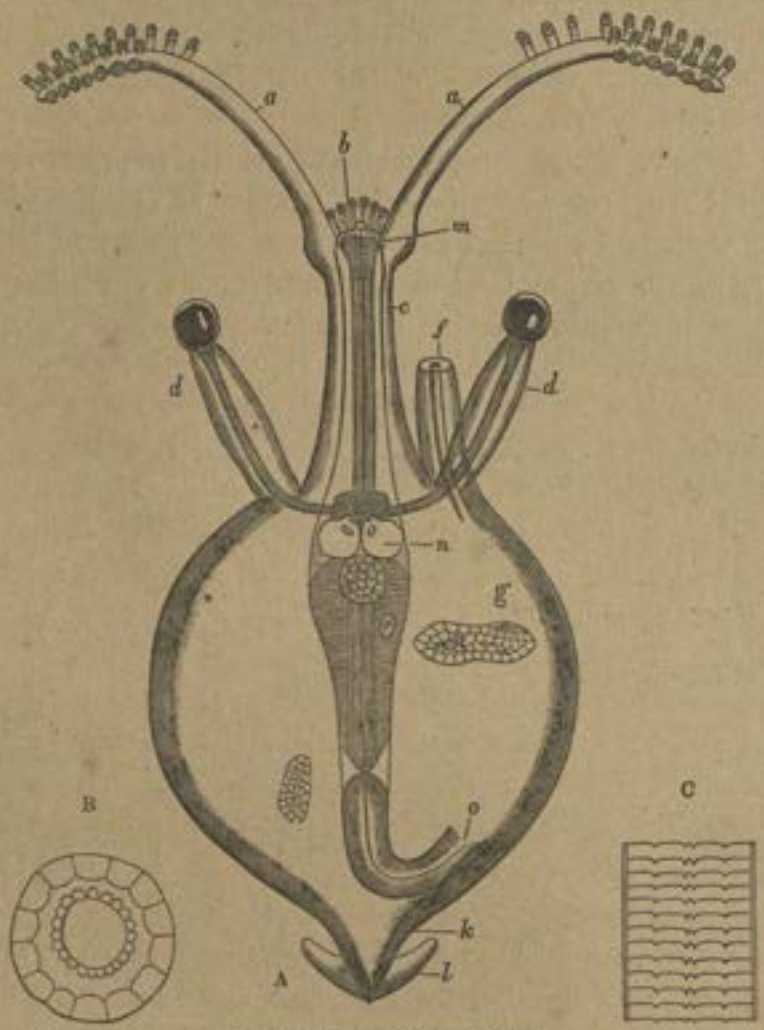

FIG. 9.—*Taonius rubra* (Lankester).

A. a living specimen, drawn by v. Willemoes-Suhm, magnified about 25 diameters. *a*, *a*, tentacles; *b*, six of the sessile arms, each bearing one sucker; *c*, the neck; *d*, *d*, the pedunculate eyes; *f*, the siphon; *g*, the ink-bag; *k*, the posterior extremity of the body, much more elongated in the adults of this genus; *l*, the fins; *m*, the buccal apparatus; *n*, the oto-cysts; *o*, the intestine. B. One of the tentacular suckers, more highly magnified. C. A portion of the radula, more highly magnified.

On a piece of paper attached to the drawing are the following particulars regarding the structure of the animal.

"Clionid Pteropod: June 16th—18th, 1874. In the warm East Australian current coming from the north (surface temperature 18° C.), together with Calcarella on the

voyage from Sydney to Wellington, lat. 34° 50′ S., long. 155° 28′ E. In all only three specimens, of which the largest alone showed the eyes well. It measured 13 mm. long; tentacles 6—7 mm. long; eye peduncles 2 mm. long. Neither of the smaller specimens showed anything new. Tentacles with suckers, of which one is strongly magnified below (woodcut 9, B). Mouth with six suckers, two teeth, and radula; the latter, as far as I could make it out without injury to the animal, is drawn below to the right hand side (woodcut 9, C). The mouth leads into an œsophagus; this into a muscular stomach, in the muscular wall of which is a unicellular gland *à la nematode*. Sharply defined intestine (*o*) which I could not follow out to the anus on the process to the right (woodcut 9, *f*). Ganglion superius sends out the nerves to the eyes; between it and the ganglion inferius are the two otolithic vesicles (*n*). On the right side the generative gland is seen with reddish oil specks, and in the corner black pigment (*g*); to the left is a cellular body, probably an excretory organ. Subsequently it seemed to me as though there was a calamus in the hindermost portion of the animal; this must however, have been a mistake. Heart not seen."

Two of the three specimens were mounted in glycerine and labelled "Clionide, 17 June, 74, Sidney—Wellington;" from one of them the mounting fluid had escaped, leaving the specimen so much dried that no efforts were successful in restoring it; in what follows it will for the sake of brevity be alluded to as the "damaged" specimen.

The second specimen was in a much better state of preservation than the first, as may be seen from the drawing (Pl. XXXII. fig. 11); it will be called the "complete" specimen.

The third specimen was labelled "Clionide, 16 June, 74, Sidney—Wellington;" it had been stained with carmine and mounted in balsam, and will be referred to as the "stained" specimen. It is the largest and is mentioned by Suhm as being the only one which showed the eyes well. Probably it contributed more than either of the others to Lankester's restoration, which is here reproduced (woodcut 10), seeing that its disposition on the slide somewhat resembles his figure, and it is the only one destitute of suckers, and seeing that the explanation of his figure specially mentions that it was taken from a "somewhat older specimen" than Suhm's.

This absence of suckers is the most important character in Lankester's definition, for, as I shall mention later, the remaining points are such as either belong properly to the genus *Taonius* or are indicative of immaturity.

Professor Lankester admits that "they may possibly have been rubbed off by rough usage of the specimens," but he inclines "to believe that they are naturally absent in the later stage." It is to be noted, however, that the "complete" specimen does possess suckers, although owing to an unfortunate accident these escaped Lankester's attention; when the specimen came into my hands a large part of it was concealed by the dark cement which had been used in fixing down the cover-glass, and which had spread over

it, probably owing to the heat of the tropics, through which it must have passed three times. The hidden portion included the oral region and the tentacles, and when the superfluous material was scraped away these were seen to present the appearance shown in Pl. XXXII. fig. 11.

Since then two out of three specimens exhibit the suckers (for they can be made out

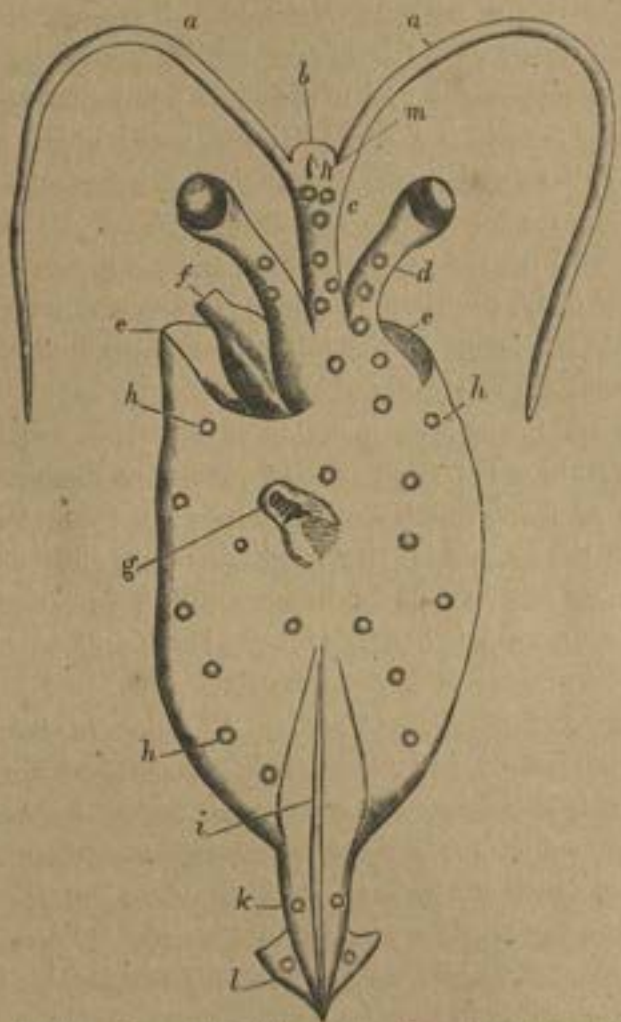

FIG. 10.—"A somewhat older specimen of *Procalistes Solasii*. Drawn by E. Ray Lankester from a specimen mounted on a glass slide in balsam by R. von Sahm. Magnified 20 diameters.

"*a*, The long 'arms' or processes of the fore-foot; *b*, the smooth buccal margin devoid of processes; *c*, the elongated neck; *d*, the pedunculated eyes; *e*, the edge of the mantle flap, separated from its attachment to the head and funnel by pressure; *f*, the funnel or siphon; *g*, the anal process seen through the transparent mantle, and showing a spiral band of black pigment lying in the ink-bag; *h*, chromatophores; *i*, the pen; *k*, the median posterior process of the body; *l*, the lateral fins attached to the same; *m*, the two horny beaks of the buccal apparatus." (Lankester, *loc. cit.*)

in the "damaged" one), and since the "complete" example is almost as large as the "stained" one, it seems to me more natural to adopt the alternative hypothesis rejected by Professor Lankester, and to believe that the suckers are not present in the one specimen because they have been accidentally removed. This view is strengthened by

the fact that the stained specimen has been largely denuded of its epidermis, which can be seen in places adhering to the tentacle and also to the circumoral region.

In addition to this, there was a small Cephalopod in the collection preserved in spirit, which there can be no reasonable doubt is identical with the three specimens above discussed although it was taken in the Atlantic. From the figure of it here given (Pl. XXXII. fig. 10) it is seen to have the same stalked eyes and long process carrying the mouth and arms, the same form of body, and (so far as can be seen) of pen, and the same distribution of chromatophores. Also since the figure just referred to was drawn I have received another specimen from Dr. Pelseneer, who found it among the collection of Pteropods on which he is engaged, and it is of special importance because it was taken at the same locality as the three examples mounted by Suhm. It resembles the Atlantic specimen so closely that the drawing might have been equally well made from either.

The arms are rudimentary and carry each one sucker, and here it may be observed that in every Cephalopod the arms pass through a stage in which they have each only one sucker. In the case of *Cranchia* and allied genera, where even in the adult the sessile arms are very short, it is only reasonable to expect this one-suckered stage at a much later period of development than in such forms as *Loligo*, where they reach a comparatively greater length, and as above mentioned (p. 185), specimens of *Cranchia reinhardtii* have been seen in the present collection, in which the arms were quite rudimentary, although the animals had attained more than one-third of their usual dimensions. In the present example the suckers stand upon small papillæ, which are obviously rudimentary arms, an arrangement not visible in the mounted specimens (see fig. 10).

Furthermore the correspondence between these small spirit specimens and the two larger ones from the Southern Ocean, which must be regarded as the types of the species, is so close that it is impossible to do otherwise than consider them as identical. The resemblance is especially great in the form of the body, and of the fin and of the head, though the neck and the ocular peduncles are not so long in the less as in the more mature specimen. This last, however, is a phenomenon seen in the development of every Cephalopod; for example, in *Sepia* the eye is much more prominent in the embryo than in the adult (compare Kölliker's drawing[1] with any of the illustrations in Pls. XVI. to XXII.) and in the case of Grenacher's pelagic larva[2] one of the stages observed (fig. 8) has the eyes distinctly pedunculate, while in a somewhat later stage this appearance is almost entirely lost (fig. 12).

If the identifications above made be correct there is no doubt that the only character by which the genus *Procalistes* can be differentiated from *Taonius* disappears, and the two genera must therefore be regarded as synonymous.

Before leaving this subject, however, it is only right to mention that Professor

[1] Entwickel. d. Cephalop., taf. iii. figs. xxvii.–xxxi., Zürich, 1844.

[2] *Zeitschr. f. wiss. Zool.*, Bd. xxiv pl. xi.

Steenstrup, with whom I had the great pleasure and profit of discussing this question, does not entirely agree with what has been advanced above, but is disposed to refer the stained specimen to a different species from the others, and that for the following reasons :—

1. The pigment spots in its mantle are very black and opaque, and circular in form, resembling those depicted in Grant's figure of *Loligopsis guttata*,[1] while those of the other specimens are much paler and with more dispersed pigment.

2. Because he was of opinion that two more or less parallel lines might be seen along the body, which seemed to represent the rows of points down the ventral surface of *Leachia*.

I am by no means prepared to say that such is not the case, and it is only with the utmost diffidence that I differ from my illustrious friend, but I think that the first point alluded to may be explained by the pigment of the chromatophores being in a state of concentration in the one case, while it was diffused in the other, and as regards the second I must confess that on repeated examination I have been unable to make out the rows of points with any certainty. On the whole, therefore, I am disposed to believe that these preparations represent only one species.

This form presents a remarkable likeness in many respects to *Loligopsis zygæna* Vérany,[2] but differs in several important particulars, so that it is impossible to regard the two as identical. The points of difference are (1) the shape of the fin, (2) the absence of suckers on the stems of the tentacles, and (3) the presence of chromatophores.

Grenacher's Pelagic Larva.

Habitat.—South Atlantic, March 21, 1876; lat. 21° 15′ S., long. 14° 2′ W.; surface temperature at noon 76°·5.

Among the microscopic preparations mounted during the voyage was one bearing the above date, which contained three embryos closely resembling those figured by Grenacher,[3] but they were not sufficiently well preserved to render it possible to make any observations of value upon them.

[1] *Trans. Zool. Soc. Lond.*, vol. i. pl. ii. figs. 1, 2.
[2] Céph. médit., pl. xl. fig. c.
[3] *Zeitschr. f. wiss Zool.*, Bd. xxiv. pp. 419-498, 1874.

Order II. TETRABRANCHIATA, Owen.

Family XXII. NAUTILIDÆ.

Nautilus, Linné.

Nautilus pompilius, Linné.

1758. *Nautilus pompilius*, Linn., Syst. nat., ed. x. p. 709; No. 283, 233.
1868. „ „ Küster, Conch. Cab., sec. 55, p. 9, taf. ii. fig. 9.

Habitat.—Station 173, off Matuku, Fiji Islands; June 24, 1874; lat. 19° 9′ 35″ S., long. 179° 41′ 50″ E.; 315 fathoms; coral mud. One specimen.

The specimen of *Nautilus pompilius* obtained by the Challenger was not in the collection when it came into my hands, so that I can give no further information regarding it than is contained in the following quotation from the Narrative.

"In dredging off Matuku Island, in 310 and 315 fathoms, on a coral bottom, some *Phorus*, *Turritella*, and a few other shells were brought up, as well as numerous specimens of the blind Crustacean, *Polycheles*, and other animals showing the fauna to be a true deep-water one.

"A living specimen of the Pearly Nautilus (*Nautilus pompilius*), so rarely seen in the living condition by any naturalist, was captured here. This was the only specimen of this animal obtained by the dredge or trawl during the voyage. The animal was very lively, though probably not so lively as it would have been if it had been obtained from a less depth, the sudden change of pressure having no doubt very much disarranged its economy. However, it swam round and round a shallow tub in which it was placed, moving after the manner of all Cephalopods, backwards, that is with the shell foremost. It floated at the surface with a small portion of the top of the shell just out of the water, as observed by Rumphius.[1] The shell was maintained with its major plane in a vertical position, and its mouth directed upwards. The animal seemed unable to sink, and the floating of the shell, as described, was due no doubt to some expansion of gas in the interior, occasioned by diminished pressure. The animal moved backwards slowly by a succession of small jerks, the propelling spouts from the siphon being directed somewhat downwards, so that the shell was rotated a little at each stroke, upon its axis, and a slightly greater area of it raised above the surface of the water. Occasionally, when the animal was frightened or touched, it made a sort of dash, by squirting out the water from its siphon with more than usual violence, so as to cause a strong eddy on the surface of the water. On either side of the base of the membranous operculum-like head-fold, which, when the animal is

[1] De Amboinsche Rariteitkamer, p. 61, Amsterdam, 1705.

retracted, entirely closes the mouth of the shell, the fold of the mantle closing the gill cavity was to be seen rising and falling, with a regular pulsating motion, as the animal in breathing took in the water, which was afterwards expelled through the siphon. The tentacle-like arms contrast strongly with those of most other Cephalopods, because of their relatively extreme slightness and shortness, though they are not shorter proportionately than those of the living *Sepia*. They are held by the animal, whilst swimming, extended radially from the head, somewhat like the tentacles in a sea anemone; but each pair has its definite and different direction, which is constantly maintained. This direction of the many pairs of tentacles at constant but different angles from the head, is the most striking feature to be observed in the living Nautilus. Thus, one pair of tentacles was held pointing directly downwards; two other pairs, situated just before and behind the eyes, were held projecting obliquely outwards and forwards, and backwards respectively, as if to protect the organs of sight. In a somewhat corresponding manner, the tentacular arms of the common cuttle-fish whilst living are maintained in a marked and definite attitude, as may be observed in any aquarium. Another living Nautilus was brought to the Consul at Kandavu during the stay of the Challenger. The natives were said to frequently catch them alive, and to give them to their chiefs, who eat them."[1]

[1] Narr. Chall. Exp., vol. i. pp. 490, 491.

GEOGRAPHICAL DISTRIBUTION.

LIST OF STATIONS,

SHOWING THE PHYSICAL CONDITIONS AND THE SPECIES OBTAINED AT EACH.

STATION 2.—South-west of Tenerife, February 17, 1873; lat. 25° 52′ N., long. 19° 22′ W.; 1945 fathoms; Globigerina ooze; bottom temperature, 36°·8; surface temperature, 67°. Dredge.

Mastigoteuthis agassizii.

North Atlantic, between Tenerife and St. Thomas, Danish West Indies.

Tremoctopus atlanticus.

St. Thomas, Danish West Indies, 8 fathoms.

Octopus tehuelchus.

North Atlantic, between St. Thomas, West Indies, and Bermuda, surface.

Teleoteuthis caribbæa.

Bermuda.

Octopus bermudensis, n. sp.

STATION 49.—South of Halifax, Nova Scotia, May 20, 1873; lat. 43° 3′ N., long. 63° 39′ W.; 85 fathoms; gravel, stones; bottom temperature, 35°; surface temperature, 40°·5. Dredge.

Rossia (?) tenera.

STATION 50.—South of Halifax, Nova Scotia, May 21, 1873; lat. 42° 8′ N., long. 63° 39′ W.; 1250 fathoms; blue mud; bottom temperature, 38°; surface temperature, 45°. Dredge.

Taonius hyperboreus.

STATION 106.—Between St. Vincent and St. Paul's Rocks, August 25, 1873; lat. 1° 47′ N., long. 24° 26′ W.; 1850 fathoms; Globigerina ooze; bottom temperature, 36°·6; surface temperature, 78°·8. Taken in a surface-net at a depth of 40 fathoms.

Cranchia reinhardtii.

North Atlantic (picked up dead from the surface).

Alloposus mollis.

Atlantic; collected from the surface.

Spirula peronii (shells).

STATION 122.—Off Barra Grande, September 10, 1873; lat. 9° 5′ S., long. 34° 50′ W.; 350 fathoms; red mud; surface temperature, 77°·5. Trawl.

Octopus januarii, n. sp.

STATION 122B.—Off Barra Grande, September 10, 1873; lat. 9° 9′ S., long. 34° 53′ W.; 32 fathoms; red mud; surface temperature, 77°·5. Trawl.

Octopus tuberculatus.

STATION 126.—Off the Rio San Francisco, Brazil, September 12, 1873; lat. 10° 46′ S., long. 36° 8′ W.; 770 fathoms; red mud; surface temperature, 77°. Trawl.

Japetella prismatica, n. sp.

Inaccessible Island, Tristan da Cunha, October 16, 1873; collected on the shore.

Octopus verrucosus, n. sp.

Simon's Bay, Cape of Good Hope, December 1873; 10–20 fathoms.

Octopus granulatus.

Cape of Good Hope, December 1873.

Argonauta argo.

Between the Cape and Marion Island.

Cranchia sp.

STATION 146.—Between Prince Edward Island and the Crozets, December 29, 1873; lat. 46° 46′ S., long. 45° 31′ E.; 1375 fathoms; Globigerina ooze; bottom temperature, 35°·6; surface temperature, 43°. Trawl.

Cirroteuthis magna, n. sp.

STATION 147.—Southern Ocean, between Prince Edward Island and the Crozets, December 30, 1873; lat. 46° 16′ S., long. 48° 27′ E.; 1600 fathoms; Diatom ooze; bottom temperature, 34°·2; surface temperature, 41°. Trawl.

Bathyteuthis abyssicola, n. sp.

STATION 151.—Off Heard Island, February 7, 1874; lat. 52° 59′ 30″ S., long. 73° 33′ 30″ E.; 75 fathoms; volcanic mud; surface temperature, 36°·2. Dredge.

Octopus levis, n. sp.

STATION 157.—Southern Ocean, March 3, 1874; lat. 53° 55′ S., long. 108° 35′ E., 1950 fathoms; Diatom ooze; bottom temperature, 32°·1; surface temperature, 37°·2. Trawl.

Eledone rotunda, n. sp.

STATION 159.—Southern Ocean, due south of Australia, March 10, 1874; lat. 47° 25′ S., long. 130° 22′ E.; 2150 fathoms; Globigerina ooze; bottom temperature, 34°·5; surface temperature, 51°·5. Trawl.

Taonius suhmi, n. sp.

STATION 162.—Off East Moncœur Island, Bass Strait, April 2, 1874; lat. 39° 10′ 30″ S., long. 146° 37′ E.; 38 fathoms; sand and shells; surface temperature, 63°·2. Dredge.

Octopus boscii, var. *pallida*, nov.

STATION 163A.—Off Twofold Bay, Australia, April 4, 1874; lat. 36° 59′ S., long. 150° 20′ E.; 150 fathoms; green mud; surface temperature, 71°. Trawl?

Octopus boscii, var. *pallida*, nov. | *Octopus duplex*, n. sp.

Sepia cultrata, n. sp.

Port Jackson, Australia, 2 to 15 fathoms.

Octopus australis, n. sp. | *Octopus pictus*, var. *fasciata*, nov.

Between Sydney and Wellington, June 16, 17, 1874. Surface.

Taonius suhmi, n. sp.

STATION 168.—East of the North Island, New Zealand, July 8, 1874; lat. 40° 28′ S., long. 177° 43′ E.; 1100 fathoms; blue mud; bottom temperature, 37°·2; surface temperature, 57°·2. Trawl.[1] Taken at the surface.

Calliteuthis reversa?

[1] The label reads "1100 fs. surface."

STATION 170.—Off the Kermadec Islands, July 14, 1874; lat. 29° 55′ S., long. 178° 14′ W.; 520 fathoms; volcanic mud; bottom temperature, 43°; surface temperature, 65°. Trawl.

Amphitretus pelagicus, n. sp.

STATION 170A.—Off the Kermadec Islands, July 14, 1874; lat. 29° 45′ S., long. 178° 11′ W.; 630 fathoms; volcanic mud; bottom temperature, 39°·5; surface temperature, 65°·2. Trawl.

Eledone verrucosa.

STATION 171.—North of the Kermadec Islands, July 15, 1874; lat. 28° 33′ S., long. 177° 50′ W.; 600 fathoms; hard ground; bottom temperature, 39°·5; surface temperature, 66°·5. Trawl.

Cirroteuthis meangensis, n. sp.

The Reefs, Tongatabu, 18 fathoms.

Octopus tonganus, n. sp.

STATION 173.—Off Matuku, Fiji Islands, July 24, 1874; lat. 19° 9′ 35″ S., long. 179° 41′ 50″ E.; 315 fathoms; coral mud; surface temperature, 76°. Dredge.

Nautilus pompilius.

The Reefs, Kandavu, Fiji.

Octopus vitiensis, n. sp.

Surface of the harbour, Kandavu, Fiji.

Sepioteuthis lessoniana.

Between Api, New Hebrides, and Cape York, August 22, 1874; from the stomach of a specimen of *Sula piscator*, which alighted on the ship.

Ommastrephes oualaniensis.

STATION 181.—Off the south-eastern extremity of Papua, August 25, 1874; lat. 13° 50′ S., long. 151° 49′ E.; 2440 fathoms; red clay; bottom temperature, 35°·8; surface temperature, 80°. Trawl.

Cirroteuthis pacifica, n. sp.

Raine Island, Torres Strait; picked up on the shore.

Spirula peronii (shells).

STATION 188.—Arafura Sea, south of Papua, September 10, 1874; lat. 9° 59′ S., long. 139° 42′ E.; 28 fathoms; green mud; surface temperature, 78°·5. Trawl and dredge.

Octopus sp.
Sepia smithi, n. sp.
Sepia papuensis, n. sp.
Sepia elliptica, n. sp.
Sepia (Metasepia) pfefferi, n. sp.
Loligo indica.

STATION 190.—Arafura Sea, south of Papua, September 12, 1874; lat. 8° 56′ S., long. 136° 5′ E.; 49 fathoms; green mud; surface temperature, 79°·2. Trawl.

Sepia elliptica, n. sp. | *Loligo indica*.

STATION 192.—Off the Ki Islands, south of Papua, September 26, 1874; lat. 5° 49′ 15″ S., long. 132° 14′ 15″ E.; 140 fathoms; blue mud; surface temperature, 82°. Trawl.

Octopus areolatus: | *Sepia sulcata*, n. sp.
Sepia kiensis, n. sp.

STATION 194A.—Off Banda, September 29, 1874; lat. 4° 31′ S., long. 129° 57′ 20″ E.; 360 fathoms; volcanic mud; surface temperature, 82°·5. Trawl.

Spirula peronii (animal).

Banda.

Octopus bandensis, n. sp.

STATION 195.—Off Amboina, October 3, 1874; lat. 4° 21′ S., long. 129° 7′ E.; 1425 fathoms; blue mud; bottom temperature, 38°; surface temperature, 82°. Trawl.

Enoploteuthis margaritifera.

Ternate, presented by the Resident.

Sepioteuthis lessoniana.

STATION 203.—Off Panay, Philippine Islands, October 31, 1874; lat. 11° 6′ N., long. 123° 9′ E.; 20 fathoms; mud; surface temperature, 85°. Trawl.

Loligo galatheæ.

STATION 207.—Off Tablas Island, January 16, 1875; lat. 12° 21′ N., long. 122° 15′ E.; 700 fathoms; blue mud; bottom temperature, 51°·6; surface temperature, 80°. Trawl.

Sepia recurvirostra.

STATION 214.—Off the Meangis Islands, February 10, 1875; lat. 4° 33′ N., long. 127° 6′ E.; 500 fathoms; blue mud; bottom temperature, 41°·8; surface temperature, 80°·5. Trawl.

Cirroteuthis meangensis, n. sp.

STATION 216A.—North of Papua, February 16, 1875; lat. 2° 56′ N., long. 134° 11′ E.; 2000 fathoms; Globigerina ooze; bottom temperature, 35°·4; surface temperature, 82°·8. Surface.

Spirula peronii (shell).

North-east of Fort D'Urville, Papua, February 22, 1875. Surface.

Spirula peronii (shell).

STATION 220.—North of Papua, March 11, 1875; lat. 0° 42′ S., long. 147° E.; 1100 fathoms; Globigerina ooze; bottom temperature, 36°·2; surface temperature, 83°·8. Trawl.

Eledonella diaphana, n. sp.

Pacific Ocean, 2° north of the Admiralty Islands, March 13, 1875; surface.

Ommastrephes oualaniensis.

North Pacific, April 3, 1875; lat. 24° 49′ N., long. 138° 34′ E. Surface.

Octopus brevipes (?).

North Pacific, off Volcano Island, April 3 and 5, 1875; about lat. 24° 49′ N., long. 138° 34′ E.

Teleoteuthis caribbæa (?).

Western Pacific, between Papua and Japan.

Tremoctopus gracilis (?).

Yokohama, Japan, purchased in the market.

Octopus macropus.
Sepia andreanoides, n. sp.
Sepia esculenta, n. sp.
Loligo edulis, n. sp.
Loligo japonica, n. sp.

STATION 232.—The *Hyalonema*-ground, off Ino Sima Island, Japan, May 12, 1875; lat. 35° 11′ N., long. 139° 28′ E.; 345 fathoms; green mud; bottom temperature, 41°·1; surface temperature, 64°·2. Dredge and trawl.

Calliteuthis reversa.

STATION 233.—Bay of Kobé, Japan, May 17–19, 1875; lat. 34° 39′ N., long. 135° 14′ E.; 8 fathoms; mud; surface temperature, 62°·3. Dredge.

Inioteuthis morsei. | *Sepia kobiensis*, n. sp.

Loligo kobiensis, n. sp.

STATION 233c.—Inland Sea, Japan, May 28, 1875; lat. 34° 18′ N., long. 133° 21′ E.; 12 fathoms; blue mud; bottom temperature, 59°·9; surface temperature, 66°·8. Trawl.

Sepiella maindroni (?). | *Loligo kobiensis*, n. sp.

Todarodes pacificus.

STATION 237.—South-east of Nosima, Japan, June 17, 1875; lat. 34° 37′ N., long. 140° 32′ E.; 1875 fathoms; blue mud; bottom temperature, 35°·3; surface temperature, 73°. Trawl.

Octopus januarii, n. sp. *Promachoteuthis megaptera*, n. sp.

Reefs, Honolulu, Sandwich Islands.

Octopus marmoratus, n. sp.

Pacific Ocean, south of the Sandwich Islands, September 2, 1875; lat. 5° 54′ N., long. 147° 2′ W. (Taken from the stomach of a shark.)

Chiroteuthis (?) sp.

STATION 271.—Central Pacific, September 6, 1875; lat. 0° 33′ S., long. 151° 34′ W.; 2425 fathoms; Globigerina ooze; bottom temperature, 35°; surface temperature, 78°·7. Trawl.

Enoploteuthis margaritifera.

South Pacific, between the Sandwich Islands and Tahiti, September 15, 1875; lat. 12° 8′ S., long. 150° 13′ W.; surface temperature, 80°.

Tremoctopus quoyanus.

Off Valparaiso, October 21, 1875; surface to 30 fathoms.

Onychoteuthis sp.

South Pacific, November 1, 5, 7, and 11, 1875; about lat. 38° 7′ S., long. 94° 4′ W.; surface.

Tracheloteuthis sp.

South Pacific Ocean, 20° W. of Patagonia, November 6, 1875; lat. 37° 50′ S., long. 93° 54′ W.

Cirroteuthis sp.

Station 298.—Off Valparaiso, November 17, 1875; lat. 34° 7′ S., long. 73° 56′ W.; 2225 fathoms; blue mud; bottom temperature, 35°·6; surface temperature, 59°. Trawl.

Cirroteuthis magna, n. sp. | *Eledone rotunda*, n. sp.

From the surface near the same locality.

Tracheloteuthis sp.

Station 313.—Off Cape Virgins, Patagonia, January 20, 1876; lat. 52° 20′ S., long. 67° 39′ W.; 55 fathoms; sand; bottom temperature, 47°·8; surface temperature 48°·2. Trawl.

Rossia sublevis (?). | *Rossia patagonica*.

Loligo ellipsura, n. sp.

Station 320.—Off Monte Video, February 14, 1876; lat. 37° 17′ S., long. 53° 52′ W.; 600 fathoms; green sand; bottom temperature, 37°·2; surface temperature, 67°·5. Trawl.

Eledone brevis, n. sp.

Station 321.—Off Monte Video, February 25, 1876; lat. 35° 2′ S., long. 55° 15′ W.; 13 fathoms; mud; surface temperature, 73°·5. Trawl.

Loligo brasiliensis.

Station 333.—Mid-South Atlantic, March 13, 1876; lat. 35° 36′ S., long. 21° 12′ W.; 2025 fathoms; Globigerina ooze; bottom temperature, 35°·3; surface temperature, 67°. Trawl.

Histiopsis atlantica, n. gen., n. sp.

South Atlantic, March 21, 1876; lat. 21° 15′ S., long. 14° 2′ W.; surface temperature at noon, 76°·5.

Grenacher's pelagic larva.

Ascension, March 27–April 3, 1876.

Octopus occidentalis, n. sp.

North Atlantic, April 12, 1876; lat. 9° 3′ N., long. 16° 35′ W.; surface temperature at noon, 81°·7. Surface.

Onychoteuthis sp.

North Atlantic, April 13, 1876; lat. 10° 48′ N., long. 17° 48′ W.; surface temperature at noon, 78°·5. Surface.

Taonius suhmi, n. sp.

St. Vincent, Cape Verde Islands, April 25, 1876; 15 to 20 fathoms.

Octopus granulatus.

North Atlantic, April 28, 1876; lat. 17° 47′ N., long. 28° 28′ W.; tow-net at night, surface; surface temperature at midnight, 73°.

Tremoctopus quoyanus.

North Atlantic, April 29, 1876; lat. 18° 8′ N., long. 30° 5′ W.; surface temperature at midnight, 73°·7. Surface at night.

Ommastrephes sp. | *Spirula peronii* (shells).

H.M.S. "Porcupine" Expedition, 1869.

Station 57.—Færöe Channel, cold area; lat. 60° 14′ N., long. 6° 17′ W.; 632 fathoms; bottom temperature, 30°·5.

Octopus arcticus.

Station 65.—Færöe Channel, cold area; lat. 61° 10′ N., long. 2° 21′ W.; 345 fathoms; bottom temperature, 29°·8.

Octopus arcticus. | *Rossia glaucopis.*

The Minch, west coast of Scotland; 60 to 80 fathoms.

Sepiola rondeleti. | *Rossia oweni.*

Off Wexford.

Rossia oweni. | *Eledone cirrosa.*

North Atlantic, about 140 miles north-west of the Irish coast; July 2, 1869; lat. 56° 10′ N., long. 13° 36′ W. Surface.

Taonius hyperboreus.

"Valorous" Expedition.

South west of Cape Farewell, Greenland, August 15, 1875; lat. 58° 45′ N., long. 48° 39′ W. Surface.

Gonatus fabricii.

East of Cape Farewell; lat. 59° 16′ N., long. 37° 16′ W.

Gonatus fabricii.

H.M.S. "KNIGHT ERRANT" EXPEDITION.

STATION 2.—Færöe Channel, cold area, July 28, 1880; lat. 60° 29′ N.; long. 8° 19′ W.; 375 fathoms; mud; bottom temperature, 31°·0; surface temperature, 53°.

Tracheloteuthis riisei.

STATION 8.—Færöe Channel, cold area, August 17, 1880: lat. 60° 3′ N., long. 5° 51′ W.; 540 fathoms; ooze; bottom temperature, 29°; surface temperature, 56°·5.

Octopus piscatorum. | *Octopus arcticus.*

H.M.S. "TRITON" EXPEDITION.

Færöe Channel, August 8, 1882; surface.

Tracheloteuthis sp.

STATION 9.—Færöe Channel, cold area, August 23, 1882; lat. 60° 5′ N., long. 6° 21′ W.; 608 fathoms; mud; bottom temperature, 30°.

Octopus piscatorum. | *Octopus arcticus.*

Off the Butt of Lewis, August 25, 1882; 40 fathoms.

Eledone cirrosa. | *Rossia oweni.*

The preceding list is a more than usually valuable one, not only because of the care with which all the localities were recorded, but also because of the accuracy with which the various physical conditions were determined at the different stations.

From a faunistic point of view, however, it is obviously very incomplete, owing to the fact that collecting in shallow water, where Cephalopods are certainly most abundant, formed a comparatively small part of the work of the Expedition, and partly also because it was from the very nature of the case impossible that any one voyage, however protracted, should explore more than a very small portion of the sea. Such being the case, and seeing that, so far as I am aware, no attempt has hitherto been made to give a complete survey of the existing species of this group arranged geographically,

I have collected whatever information the specimens in my hands and the literature of the subject afforded in the subjoined lists.

As regards their distribution the Cephalopoda seem to be divisible into three principal groups (1) the Pelagic, (2) the Littoral, (3) the Abyssal, and the different genera belong with considerable constancy to one group or the other, that is to say, all the species of any one genus belong to the same group; for example—*Octopus*, *Sepia*, and *Loligo* are typical littoral genera, while *Cranchia*, *Ommastrephes*, and *Onychoteuthis* are with equal distinctness pelagic in their habits.

It has been stated generally, and the examination of the Challenger collection has certainly borne out the proposition, that while pelagic animals belong to but few types, each of which has a comparatively wide area of distribution, littoral forms belong to many species, each of which is confined within narrow limits. With reference to deep-sea forms our knowledge is only in its infancy, but they seem to be even more widely distributed than the pelagic ones; and conditions of life in the depths of the sea (especially temperature) are so uniform that this is precisely what we should expect, and what has been found to obtain in other groups.

The first three lists give what I may call the "Oceanic" species, using this word to include both the pelagic and abyssal forms, for it is convenient to consider them together as regards their horizontal distribution: their vertical distribution will be treated of in the next section of this Report. These forms have been disposed in three groups corresponding to the Atlantic, Pacific, and Indian (including the Southern) Oceans rather for convenience than from a belief that such a division is natural; although, as will appear subsequently (p. 222), the great majority are confined to one area. The chief factor limiting their dispersion being probably temperature, though doubtless other conditions, such as the presence of Gulf weed, also have their influence.

The "Littoral" species, that is those found in moderately shallow water not far from the coasts, whether they be active swimmers like *Loligo*, or more sedentary like *Octopus*, are much more restricted in their range than the oceanic. For the purpose of representing their distribution, the coasts of the world have been divided into seventeen regions, which are very different in extent and in the number of species that have been recorded from them; as regards the former of these points it may be remarked that no sharp boundaries can be drawn between them at all; for, although for statistical purposes it may be necessary to adopt lines of demarcation, these are not recognised by nature, and furthermore a fuller knowledge of the faunas of the various regions would almost certainly show that some of the districts here proposed should be subdivided and others united.

The geographical regions here adopted agree very closely with those proposed by Dr. Paul Fischer in his recent Manual, based upon a study of the whole of the Mollusca. In a few cases I have subdivided his districts, in more he has subdivided

mine. The subjoined comparative scheme shows approximately the relations of the different divisions :—

Fischer.	Hoyle.
1. Arctique,	XVII. Arctic.
2. Boréale, 3. Celtique,	I. Scandinavian.
4. Lusitanienne,	IV. Lusitanian. V. Mediterranean.
5. Aralo-caspienne,	
6. Africaine occidentale,	VI. West African.
7. Africaine australe,	VII. South African.
8. Indo-pacifique,	VIII. Red Sea. IX. Indo-Malay. XIII. Insular Pacific.
9. Australo-zélandaise,	XI. Australian. XII. New Zealand.
10. Japonaise,	X. Japanese.
11. Aleutienne, 12. Californienne,	XIV. Californian.
13. Panamique, 14. Péruvienne,	XV. Peruvian.
15. Magellanique, 16. Patagonienne,	XVI. Patagonian.
17. Caraïbe,	III. West Indian.
18. Transatlantique,	II. New England.

The geographical position of each region will be indicated in the sequel, and is shown upon the accompanying map; the boundary between the littoral regions and the oceanic provinces has been taken at the 500 fathom line for the abyssal forms; as regards the pelagic forms obviously no line can be drawn, for most characteristic oceanic surface forms are not *unfre*quently found quite near to the coast.

When a species has been recorded from more than one region the letter or number corresponding to each additional region is placed after its name; † indicates that the species is recorded from that province in the present Report.

OCEANIC SPECIES.

A. The Atlantic Oceanic Region.

Cirroteuthis umbellata.
,, *plena.*
,, *megaptera.*
Stauroteuthis syrtensis (also II.).
Opisthoteuthis agassizii (also II. III.).
Argonauta argo (also C. II. IV. V. VII. IX. XI.).
Argonauta hians (also C. IX.).
† *Tremoctopus quoyanus* (also C.).
† ,, *atlanticus.*
,, *microstomus* (also V.).
,, *hyalinus.*
† *Allopsus mollis* (also II.).
Octopus lentus (also II.).

† *Octopus piscatorum* (also I. II.).
† „ *arcticus* (also I. II.).
„ *gracilis*.
„ *brevipes* (also C.).
Eledone verrucosa (also C. II.).
† „ *brevis*.
Eledonella pygmæa.
† *Japetella prismatica*.
Bolitæna microcotyla.
Sepiola pusilla.
Rossia megaptera (also II.).
Ommastrephes bartramii (also B. II. V.).
„ *pteropus* (also I. V.).
„ *pelagicus* (also III.).
Todarodes sagittatus (also I. IV. V.).
Illex illecebrosus (also II.).
† *Tracheloteuthis riisei* (also V. XIII.).
Architeuthus monachus.
„ *dux* (also I.).
„ *harveyi* (also II.).
„ *princeps* (also II.).
Bathyteuthis megalops.
Steenstrupiola atlantica.
† *Mastigoteuthis agassizii*.
Enoploteuthis leptura (also C.).
„ *pallida*.
Ancistrocheirus megaptera.
Abralia morisii.
Onychoteuthis banksii (also B. C. XII.).
† *Teleoteuthis caribbæa* (also C.).
† *Gonatus fabricii* (also C. II. V. XVII.).
Doratopsis diaphana.
Cheiroteuthis bonplandi.
„ *lacertosa* (also II.).
Brachioteuthis beanii (also II.).
Calliteuthis reversa (also II. X.).
† *Histiopsis atlantica*.
Cranchia scabra (also III.).
„ *megalops*.
† „ *reinhardtii*.
„ *maculata*.
Taonius pavo (also II.).
† „ *hyperboreus* (also II. XVII.).
„ *cymoctypus*.
† „ *suhmi* (also B. C.).
Leachia cyclura (also B. C.).
Leachia ellipsoptera.

B. The Indian and Southern Oceanic Region.

† *Cirroteuthis magna* (also C.).
† *Eledone rotunda* (also C.).
Sepiadarium kochii.
Idiosepius pygmæus (also IX.).
Ommastrephes bartramii (also A. II. V.).
„ *oualaniensis* (also C.).
Tracheloteuthis behnii (also C. IX.).
† *Bathyteuthis abyssicola*.
Abralia armata.
Onychoteuthis banksii (also A. C. XII.).
Ancistroteuthis dussumieri.
Teleoteuthis platypera (also C.).
„ *peratoptera* (also C.).
† *Taonius suhmi* (also A. C.).
Leachia cyclura (also A. C.).

C. The Pacific Region.

† *Cirroteuthis magna* (also B.).
† „ *meangensis*.
† „ *pacifica*.
† *Amphitretus pelagicus*.
† ? *Tremoctopus gracilis*.
† „ *quoyanus* (also A.).

Argonauta argo (also A. II. IV. V. VII. IX. XI.).
„ *tuberculata* (also VII. IX. XI. XII.).
„ *hians* (also A. IX.).
† ? *Octopus brevipes* (also A.).
„ *januarii* (also III.).
† *Eledone verrucosa* (also A. II.).
† „ *rotunda* (also B.).
† *Eledonella diaphana.*
† *Promachoteuthis megaptera.*
Loliolus affinis.
Ommastrephes gigas.
† „ *oualaniensis* (also B.).
Todarodes sloanii (also XII.).
Tracheloteuthis behnii (also B. IX.).
Enoploteuthis leptura (also A.).
† „ *margaritifera* (also V.).
Cucioteuthus unguiculatus.
Ancistrocheirus leseurii.
Onychoteuthis banksii (also A. B. XII.).
„ *æquimana.*
† ? *Telcoteuthis caribbæa* (also A.).
„ *platyptera* (also B.).
„ *peratoptera* (also B.).
Gonatus fabricii (also A. II. V. XVII.).
† *Taonius suhmi* (also A. B.).
Leachia cyclura (also A. B.).

LITTORAL SPECIES.

I. The Scandinavian Region.

This region includes the whole of the Scandinavian Peninsula, Denmark, Holland, Iceland, and the northern half of the British Isles.

Octopus vulgaris (also III. IV. V. VI. VII. VIII. IX. X. XIII.).
† „ *piscatorum* (also A. II.).
† „ *arcticus* (also A. II. XVII.).
† *Eledone cirrosa* (also IV. V.).
† *Sepiola rondeleti* (also IV. V. VI.).
„ *atlantica* (also XVII.).
? *Rossia macrosoma* (also V. XVII.).
† „ *oweni.*
† „ *glaucopis* (also XVII.).
Sepia officinalis (also IV. V. VI.).
Loligo vulgaris (also IV. V.).
„ *forbesii* (also IV.).
„ *breviceps.*
„ *media* (also IV. V.).
Ommastrephes pteropus (also A. V.).
Todarodes sagittatus (also A. IV. V.).
Illex coindetii (also IV. V.).
Architeuthus monachus (also A.).
„ *dux* (also A.).

II. The New England Region.

The northern boundary of this region I am unable to fix, probably it extends up to the coast of Labrador; southwards it extends about as far as Cape Hatteras.

Stauroteuthis syrtensis (also A.).
Opisthoteuthis agassizii (also A. II.).
Argonauta argo (also A. C. IV. V. VII. IX. XI.).
Ocythoë tuberculata (also V.).
Alloposus mollis (also A.).
Octopus lentus (also A.).
„ *obesus.*

Octopus piscatorum (also A. I.).
,, *arcticus* (also A. I. XVII.).
? ,, *carolinensis*.
Eledone verrucosa (also A. C.).
Stoloteuthis leucoptera.
Rossia hyatti.
,, *sublevis* (also XVI.).
† *Rossia tenera* (also III.).
,, *megaptera* (also A.).
Loligo pealei.
Lolliguncula brevis (also III.).
Ommastrephes bartramii (also A. B. V.).
Ommastrephes megapterus.
Illex illecebrosus (also A.).
Architeuthus harveyi (also A.).
,, *princeps* (also A.).
Gonatus fabricii (also A. C. V. XVII.).
Teleoteuthis agilis.
Chiroteuthis lacertosa (also A.).
Brachioteuthis beanii (also A.).
Calliteuthis reversa (also A. X.).
Histioteuthis collinsii.
Taonius pavo (also A.).
Taonius hyperboreus (also A. XVII.).

III. The West Indian Region.

This province extends southwards from the last, about as far as the mouth of the Rio de la Plata, and includes the Gulf of Mexico and the shores of the islands at its mouth.

Opisthoteuthis agassizii (also A. II.).
Octopus vulgaris (also I. IV. V. VI. VII. VIII. IX. X. XIII.).
,, *occidentalis* (also VI.).
,, *tuberculatus* (also V. VI.).
,, *granulatus* (also IV. VI. VII. IX. XV.).
† ,, *tehuelchus* (also XVI.).
,, *verrilli*.
† ,, *bermudensis*.
† ,, *januarii* (also C.).
,, *filosus*.
Nectoteuthis pourtalesii.
Rossia brachyura.
Rossia tenera (also II.).
Spirula peronii (also IX. XI.).
Sepia antillarum.
Sepioteuthis sepioidea.
,, *ehrhardti*.
,, *ovata*.
,, *sloanii*.
† *Loligo brasiliensis*.
,, *gahi* (also XV. XVI.).
,, *plei*.
Lolliguncula brevis (also II.).
Ommastrephes pelagicus (also A.).
Abralia megalops.
Cranchia scabra (also A.).
Cranchia tenuitentaculata.

IV. The Lusitanian Region.

This region includes the southern half of the British Isles, the coasts of France, Spain and Africa, about as far as the Canary Islands. It is, of course, closely related to the Mediterranean Region, but that sea contains so many forms which appear to be peculiar to it that it appeared best to regard it provisionally as a distinct region.

Argonauta argo (also A. C. II. V. VII. IX. XI.).
Octopus vulgaris (also I. III. V. VI. VII. VIII. IX. X. XIII.).
„ *granulatus* (also III. VI. VII. IX. XV.).
Eledone cirrosa (also I. V.).
Sepiola rondeleti (also I. V. VI.).
„ *atlantica.*
Sepia officinalis (also I. V. VI.).
„ *filliouxi* (also V.).
„ *fischeri.*
Sepia orbignyana (also V.).
„ *ruppellaria* (also V.).
Loligo vulgaris (also I. V.).
„ *affinis.*
„ *macrophthalma.*
„ *microcephala.*
„ *moulinsi.*
„ *forbesii.*
„ *media* (also I. V.).
Ommastrephes crassus.
Todarodes sagittatus (also A. I. V.).
Illex coindetii (also I. V.).

V. The Mediterranean Region.

The Mediterranean and Black Seas make up this region. Strictly speaking, here also a subdivision should be made, like that adopted in regard to the oceans, separating the pelagic from the littoral forms; but the distinction does not seem to be so clearly marked, perhaps owing to the subject not having been sufficiently investigated.

Argonauta argo (also A. C. II. IV. VII. IX. XI.).
Ocythoë tuberculata (also II.).
Tremoctopus violaceus.
„ *microstomus* (also A.).
„ *ocellatus.*
? *Octopus vulgaris* (also I. III. IV. VI. VII. VIII. IX. X. XIII.).
„ *salutii.*
„ *tuberculatus* (also III. VI.).
„ *de filippi.*
„ *macropus* (also VI. VIII. IX. X.).
„ *alderii.*
Scæurgus tetracirrhus.
„ *titanotus.*
„ *unicirrus.*
Eledone moschata.
„ *cirrosa* (= *Eledone aldrovandi*) (also I. IV.).
Sepiola rondeleti (also I. IV. VI.).
? „ *oweniana* (also XIII.).
Rossia macrosoma (also I. XVII.).
Heteroteuthis dispar.
Sepia officinalis (also I. IV. VI.).
„ *filliouxi* (also IV.).
„ *orbignyana* (also IV.).
„ *elegans.*
„ *ruppellaria* (also IV.).
Loligo vulgaris (also I. IV.).
„ *media* (also I. IV.).
Thysanoteuthis rhombus.
„ *elegans.*
Ommastrephes bartramii (also A. B. II.).
? „ *æquipodus.*
„ *pteropus* (also A. I.).
Todarodes sagittatus (also A. I. IV.).
Illex coindetii (also I. IV.).

Dosidicus eschrichtii.
Tracheloteuthis riisei (also A. XII.).
Abralia polyonyx.
,, *veranyi.*
,, *oweni.*
Enoploteuthis margaritifera (also C.).
Verania sicula.
Ancistroteuthis lichtensteinii.
Teleoteuthis krohnii.
Gonatus fabricii, (also A. C. II. XVII.).
Chiroteuthis veranyi.
Histioteuthis bonelliana.
,, *ruppelli.*
Doratopsis vermicularis.

VI. The West African Region.

The district thus named extends from the Canaries to about the Tropic of Capricorn.

Octopus vulgaris (also I. III. IV. V. VII. VIII. IX. X. XIII.).
,, *tuberculatus* (also III. V.).
† ,, *occidentalis* (also III.).
† ,, *granulatus* (also III. IV. VII. IX. XV.).
Octopus macropus (also V. VIII. IX. X.).
Sepiola rondeleti (also I. IV. V.).
Sepia officinalis (also I. IV. V.).
,, *hierredda.*
,, *bertheloti.*
Sepiella ornata.

VII. The South African Region.

A considerably greater area has been allotted to this province than is given to the corresponding one in Dr. Fischer's arrangement. It has been allowed to extend from the Cape as far as the Red Sea and to include the Madagascar and Mauritius, as well as the islands of the South Atlantic and Southern Oceans, the Tristan and Prince Edward groups, with the Kerguelen and Heard Islands.

† *Argonauta argo* (also A. C. II. IV. V. IX. XI.).
,, *tuberculata* (also C. IX. XI. XII.).
Octopus vulgaris (also I. III. IV. V. VI. VIII. IX. X. XIII.).
† ,, *verrucosus.*
† ,, *granulatus* (also III. IV. VI. IX. XV.).
? ,, *horridus* (also VIII.).
,, *aranea* (also XIII.).
,, *levis.*
Cistopus indicus (also IX.).
Sepiola stenodactyla.
Sepia vermiculata.
,, *zanzibarica.*
,, *venusta.*
,, *capensis.*
,, *tuberculata.*
Hemisepius typicus.
Sepioteuthis mauritiana.
,, *loliginiformis* (also VIII.).
,, *madagascariensis.*
Loligo reynaudii.
Monchezia sancti-pauli.
Enoploteuthis hoylei.
Pyrgopsis rhynchophorus.
Taonius (?) maximus.

VIII. The Red Sea.

This has been separated as a distinct region, since it seems to contain several peculiar forms.

Octopus vulgaris (also I. III. IV. V. VI. VII. IX. X. XIII.).
,, *horridus* (also VII.).
,, *macropus* (also V. VI. IX. X.).
Sepia savignyi.
Sepia rouxii (also IX.).
,, *elongata.*
,, *lefebrei.*
,, *gibbosa.*
Sepioteuthis loliginiformis (also VII.).
Loligo arabica.

IX. The Indo-Malayan Region.

This province I regard as extending from the Red Sea eastward and northward somewhat further than the Island of Formosa, and as including the Philippines, Papua and all the Malay Archipelago. Probably a portion of the northern coast of Australia should be added, as is done by Fischer, but of this I am not certain.

Argonauta argo (also A. C. II. IV. V. VII. IX. XI.).
,, *tuberculata* (also C. VII. XI. XII.).
,, *hians* (also A. C.).
Octopus vulgaris (also I. III. IV. V. VI. VII. VIII. X. XIII.).
,, *granulatus* (also III. IV. VI. VII. XV.).
† ,, *areolatus* (also X.).
,, *aculeatus* (also XIII.).
,, *macropus* (also V. VI. VIII. X.).
† ,, *bandensis.*
,, *membranaceus.*
,, *punctatus* (also X. XIV.).
Cistopus indicus (also VII.).
Sepiola schneehageni.
,, *rossiæformis.*
,, *penares.*
Idiosepius pygmæus (also B.).
† *Spirula peronii* (also III. XI.).
† *Sepia smithi.*
† ,, *papuensis.*
,, *pagenstecheri.*
,, *singaporensis.*
,, *latimanus* (also XI.).
,, *aculeata.*
,, *indica* (also XI.).
,, *rostrata* (also XI.).
,, *rouxii* (also VIII.).
† ,, *elliptica.*
,, *brevimana.*
† ,, *recurvirostra.*
† ,, *sulcata.*
† ,, *kiensis.*
† ,, *pfefferi.*
,, *brachycheira.*
Sepiella inermis.
,, *curta.*
,, *ocellata.*
,, *maindroni* (also X.).
Sepioteuthis blainvilliana.
,, *neoguinaica.*

† *Sepioteuthis lessoniana* (also X. XII. XIII.).
Loligo sumatrensis.
„ *duvaucelii.*
† „ *indica.*
Loligo subalata.
† „ *galatheæ.*
Trachelioteuthis behnii (also B. C.).
Teleoteuthis curta.
Cranchia brockii.

X. The Japanese Region.

The coasts of these islands have yielded so many remarkable Cephalopods that it seems advisable to separate them, provisionally at all events, as a distinct region.

Octopus vulgaris (also I. III. IV. V. VI. VII. VIII. IX. XIII.).
„ *areolatus* (also IX.).
† „ *macropus* (also V. VI. VIII. IX.).
„ *globosus.*
† „ *punctatus* (also IX. XIV.).
Inioteuthis japonica.
† „ *morsei.*
? *Sepia myrsus.*
† „ *esculenta.*
„ *andreana.*
„ *peterseni.*
† „ *andreanoides.*
† *Sepia kobiensis.*
„ *tullbergi.*
† *Sepiella maindroni* (also IX.).
Sepioteuthis lessoniana (also IX. XII. XIII.).
„ *brevis.*
† *Loligo kobiensis.*
„ *bleekeri.*
† „ *chinensis.*
† „ *edulis.*
† „ *japonica.*
† *Todarodes pacificus.*
† *Calliteuthis reversa* (also A. II.).
Calliteuthis ocellata.

XI. The Australian Region.

The whole Australian continent is here regarded as forming a single region; as above remarked it is quite probable that the northern portion of it should be placed in the last division, but so little information regarding the species from that district has come into my hands that I forbear from drawing any line. Fischer makes an arbitrary boundary at the Tropic of Capricorn.

Argonauta argo (also A. C. II. IV. V. VII. IX.).
„ *tuberculata* (also C. VII. IX. XII.).
Octopus boscii.
„ „ var. *pallida.*
Octopus tetricus.
„ *superciliosus.*
† „ *australis.*
„ *tenebricus.*
† „ *duplex.*
† „ *pictus.*

† *Octopus pictus*, var. *fasciata*.
„ *polyzenia*.
„ *cornutus*.
Sepiola tasmanica.
Sepioloidea lineolata.
Spirula peronii (also III. IX.).
Sepia plangon.
„ *latimana* (also IX.).
„ *indica* (also IX.).
„ *rostrata* (also IX.).
Sepia australis.
„ *mestus*.
„ *cultrata*.
„ *apama* (also XII.).
„ *palmata*.
Sepioteuthis australis.
„ *lunulata* (also XII.).
Loligo australis.
Nautilus stenomphalus.
Nautilus pompilius (also XIII.).

XII. The New Zealand Region.

The Cephalopod fauna of these islands is so peculiar that it seems advisable to separate them from the Australian region, to which they are no doubt nearly allied, though, as will be seen above, the number of forms proved to be common to both is very few.

Argonauta tuberculata (also C. VII. IX. XI.).
„ *gracilis*.
Octopus maorum.
„ *communis*.
Pinnoctopus cordiformis.
Sepiola pacifica.
Sepia apama (also XI.).
Sepioteuthis bilineata.
„ *lessoniana* (also IX. X. XIII.).
Todarodes sloanii (also C.).
Onychoteuthis banksii (also A. B. C.).

XIII. The Pacific Insular Region.

The shores of the various archipelagos in the Pacific Ocean seem to be inhabited by numerous Cephalopods which are quite distinct from the pelagic forms inhabiting the open ocean. But few collections have as yet been made of these; not enough to enable any general conclusions regarding their affinities to be drawn.

? *Octopus vulgaris* (also I. III. IV. V. VI. VII. VIII. IX. X.).
† „ *tonganus*.
† „ *vitiensis*.
† „ *marmoratus*.
„ *aculeatus* (also IX.).
Octopus hawaiensis.
„ *aranea* (also VII.).
„ *lunulatus*.[1]
? *Sepiola oweniana* (also V.).
Sepia polynesica.

[1] Hutton (Man. Moll. N. Zeal., p. 1) has corrected d'Abigny's statement that this species is from New Zealand; Quoy and Gaimard say, "le havre Carteret à la Nouvelle Irlande."

Sepioteuthis lunulata (also XI.).
† „ *lessoniana* (also IX. X. XII.).
Loligo pfefferi.
„ *spectrum.*
Tracheloteuthis riisei (also A. V.).
Nautilus pompilius (also XI.).
„ *scrobiculatus.*
„ *macromphalus.*
„ *umbilicatus.*

XIV. The Californian Region.

This region I regard as stretching from the peninsula of Alaska to the Isthmus of Panama; probably it will eventually be necessary to subdivide it, but so few forms have been described from that coast, that this course hardly seems advisable at present. From the coast between Alaska and Kamtschatka no Cephalopods are known to me; probably they will be found like the other Mollusca from that region to be of Arctic types.

Argonauta pacifica.
„ *expansa.*
Octopus bimaculatus.
Octopus punctatus (also IX. X.).
Loliolus steenstrupi.
Onychoteuthis lobipennis.
Ancistroteuthis robusta.

XV. The Peruvian Region.

The northern boundary of this province may be taken at the Isthmus of Panama and the southern at about the northern limit of Patagonia.

Octopus granulatus (also III. IV. VI. VII. IX.).
fontanianus (also XVI.).
Loligo gahi (also III. XVI.).
Steenstrupiola chilensis.[1]
Onychoteuthis brachyptera.[1]
Taonius schneehageni.[1]

XVI. The Patagonian Region.

This region includes the extremity of South America, both on the eastern and western coasts.

Octopus fontanianus (also XV.).
„ *tehuelchus* (also III.).
† *Rossia patagonica.*
Rossia sublevis (also II.).
Loligo gahi (also III. XV.).
„ *patagonica.*
Onychoteuthis ingens.

[1] Probably these species are Oceanic.

XVII. The Arctic Region.

The coasts of Greenland, Spitzbergen, and the seas within the Arctic circle, so far as they have been explored, constitute this region.

Cirroteuthis mülleri.
Octopus arcticus[1] (also A. I. II.).
Sepiola atlantica (also I.).
Rossia macrosoma[2] (also I. V.).
Rossia palpebrosa.
„ *glaucopis* (also I.).
„ *mölleri.*
Gonatus fabricii (also A. C. II. V.).
Taonius hyperboreus (also A. II.).

The general statements above made may be tested by reference to these statistical tables.

The species enumerated in the Oceanic lists are distributed thus :—

66	species are recorded	from	only one Oceanic area.
15	„	„	two Oceanic areas.
3	„	„	three „

These numbers show that about 75 per cent. of the oceanic forms are confined to one ocean, and that cosmopolitan forms must be regarded as exceptional.

The species enumerated in the seventeen Littoral lists may be arranged thus :—

199	species are recorded	from	only one Littoral area.
27	„	„	two Littoral areas.
12	„	„	three „
4	„	„	four „
1	„	„	five „
2	„	„	six „
1	„	„	ten „

About 80 per cent. therefore of these forms are confined to one region, a striking confirmation of the proposition made on p. 211.

Thirty-five species are recorded from both Oceanic and Littoral regions, but the majority of these are typically pelagic, and hence their occurrence in the latter areas must be regarded as accidental; furthermore it will be seen that almost without exception the littoral regions where a species has been found are those bordering upon its proper ocean, which is precisely what would have been expected.

[1] Recorded by Dewhurst as *Sepia grœnlandica* (Nat. Hist. Cetacea, p. 263, London, 1834), and by Møller as *Octopus granulatus* (Ind. Moll. groenl., p. 3). Most of the species enumerated above occur in Mörch's list in Rink, Danish Greenland, p. 440, London, 1877.

[2] This is more likely to be *Rossia oweni.*

The most remarkable instances of wide distribution are *Octopus macropus* (from five regions), *Octopus granulatus* and *Argonauta argo* (each from six), and *Octopus vulgaris* (from ten regions); but with regard to each of these it is probable that other species have been recorded under the names of the better known ones. This is more especially likely in the last instance, for the specific name *vulgaris* seems to impress certain minds with the idea that the commonest form in all regions must be referable to it.

The genus *Sepia*, in contradistinction to *Octopus* and *Loligo* which are cosmopolitan, presents us with a very interesting case of wide but yet definitely limited distribution. The different distributional regions contain the following numbers of species :[1]—

I. Scandinavian,	1	X. Japanese,	9
II. New England,	0	XI. Australian,	9
III. West Indian,	1	XII. New Zealand,	1
IV. Lusitanian,	5	XIII. Pacific Insular,	1
V. Mediterranean,	5	XIV. Californian,	0
VI. West African,	4	XV. Peruvian,	0
VII. South African,	5	XVI. Patagonian,	0
VIII. Red Sea,	5	XVII. Arctic,	0
IX. Indo-Malayan,	19		

From this summary it appears, in the first place, that the whole American continent is devoid of any species of this genus, and that from the islands only one species has been recorded and that a very doubtful one (*Sepia antillarum*, d'Orb.). The opposite hemisphere, however, is just as rich in species as this one is poor, and the greatest abundance is seen to be in the Indo-Malayan region, from which no less than nineteen forms have been recorded, while the remaining districts seem to contain fewer types pretty nearly in proportion as they are removed from this centre; thus Japan and Australia each have nine; the Red Sea, South Africa and the Mediterranean each five, while the Scandinavian region has only one. The conclusion is most forcibly suggested that this genus was first developed in this part of the world and has gradually spread, *Sepia antillarum* being as it were a pioneer leading the way to the occupation of the Western Hemisphere.

An interesting correspondence has often been remarked between the Scandinavian and New England regions; Verrill has called attention to it as regards the Mollusca as a whole, and I have elsewhere given a comparison between the Ophiuroidea from the two sides of the Atlantic.[2] As regards the Cephalopoda the resemblance between the two faunas is not striking, especially at first sight, only *Octopus piscatorum* and *Octopus arcticus* being actually common to the two; but it must be remembered that several of the species of *Rossia* resemble each other closely (*e.g.*, *Rossia glaucopis* of the European, and *Rossia hyatti* of the American waters), while there is no doubt that *Illex illecebrosus* and *Illex coindetii* are very nearly allied to each other. This resemblance

[1] Species of the genus *Sepiella* are here included.

[2] *Proc. Roy. Soc. Edin.*, vol. xii. p. 727, 1884.

is rendered less strange by the considerations, that it is most marked in the case of the species from deep and cold water, and that the faunas of both sides of the Atlantic are similarly related to the forms from the Arctic Ocean (compare regions I., II., and XVII.).

An apparent resemblance, less easy to account for, if it be found really to exist, is that between the Western Pacific and the Western Atlantic, to which allusion has already been made in the pages of this Report (pp. 105, 107, 184). A number of identical or allied species are common to both, as may be seen from the subjoined list :—

Western Atlantic.	Western Pacific.
Cirroteuthis plena.	*Cirroteuthis magna.*
„ *megaptera.*	„ *meangensis.*
	„ *pacifica.*
Octopus januarii, ...	*Octopus januarii.*
Eledone verrucosa, ...	*Eledone verrucosa.*
Eledonella pygmæa, ...	*Eledonella diaphana.*
Calliteuthis reversa, ...	*Calliteuthis reversa.*

It is possible that this resemblance may, upon further examination, prove to be delusive. *Cirroteuthis* is a genus whose members appear to be rather widely distributed in deep water; and *Eledone verrucosa* and *Octopus januarii* seem to be inhabitants of moderately deep water, and will perhaps be dredged up from intermediate points, while *Eledonella* is probably a pelagic genus, and if so is of no weight whatever in the consideration of distributional problems. It seemed worth while, however, to state the facts clearly as at present known, if only for the sake of directing attention to them.

A relation between the marine faunas of Japan and Western Europe has been pointed out in the case of fish by Dr. Günther, and in the case of mollusca by the late Dr. Gwyn Jeffreys,[1] but the study of the Cephalopoda has not made any additions to the list of common forms. A matter of interest in this connection, however, is the capture of specimens of *Enoploteuthis* in the Malay Archipelago and in the Pacific, which I see no reason for distinguishing from the *Enoploteuthis margaritifera* of the Mediterranean; a fact which suggests the possibility of a connection having taken place between the Mediterranean and the Indian Ocean, although, so far as it has yet been studied, the Cephalopod fauna of the Red Sea does not lend much support to this hypothesis. I understand, however, from Professor Geikie, that there is strong geological evidence in its favour, and, if so, the migration which has led to the existence of similar forms in the seas of Japan and Western Europe, may have taken place round the south, and not round the north of Asia as has generally been supposed.

[1] *Journ. Linn. Soc. Lond.*, vol. xii. pp. 100–109 ; see also Hoyle, *tom. cit. supra*, p. 717.

BATHYMETRICAL DISTRIBUTION.

Only slight materials are at present available for drawing any conclusions as to the Bathymetrical Distribution of the Cephalopoda. This is due, in the first place, to the fact that it is only quite recently that any record has been kept of the depth from which specimens were obtained, all our museums having considered it sufficient to indicate the localities of the various species.

Since the introduction of deep-sea dredging, however, a change in this respect has set in, but even yet the collections of the Challenger and of the United States Fish Commission and Coast Survey furnish by far the greater proportion of the accurate data available for discussion, although, no doubt, the investigations of the "Talisman" and "Travailleur" will furnish welcome additions when published.

Another consideration, however, greatly diminishes our real knowledge in this matter, and it is the fact, which has often been commented on in the present series of Reports, that it by no means follows that specimens procured necessarily inhabit the greatest depth reached by the dredge. In the case of animals so gifted with locomotor powers as the Cephalopoda it is peculiarly impossible to obtain certainty in this respect, and, consequently, every recorded instance of the occurrence of a member of this group in deep water requires to be discussed on its own merits, and by the aid of whatever collateral evidence may be available.

Before proceeding further it will be well to give, in a tabulated form, the information yielded by the Challenger collection, supplemented by whatever could be obtained from the literature of the subject or other trustworthy sources. No general statements, such as "shallow water," "moderate depths," have been admitted, but only those in which a definite number of fathoms was recorded; had the former been included the list of species found above the 100 fathom line would have been much more extensive.

The figures indicate the depth in fathoms, and the letters the sources of information; thus:—

Ch = Challenger collection.	**S** = Professor G. O. Sars.
K = "Knight Errant" collection.	**T** = "Triton" collection.
P = "Porcupine" collection (Expedition of 1869).	**V** = Professor Verrill.
	Val = "Valorous" collection.

The numbers enclosed in square brackets indicate recorded depths which are almost certainly erroneous.

TABLE I.—*Species recorded from the Surface.*

Species.	Challenger.	Other British Expeditions.	American Expeditions.	Other Sources and Remarks.	Also in Table
Amphitretus pelagicus, n. sp.,	[520]				
Argonauta argo,			V.		
Tremoctopus quoyanus,	Ch.				
„ *gracilis* (?),	Ch.				
„ *atlanticus*,	Ch.				
Alloposus mollis,	Ch.		V.	Dead.	I. IV. V. VI.
Octopus brevipes (?),	Ch.				
Eledonella diaphana, n. sp.,	[1100]				
Sepioteuthis lessoniana,	Ch.				
Ommastrephes bartramii,			V.	Recorded Ceph. N. E. Amer., p. 388.	
„ *oualaniensis*,	Ch.				
Todarodes sagittatus,				S.	
Illex illecebrosus,			V.		III. IV.
Teleoteuthis caribbæa,	Ch.			Lesr.	
„ *agilis*,			V.		
Gonatus fabricii,		Vol.		Steenstrup has shown reason for thinking that this form also occurs in the deep sea.	IV. V.
Chiroteuthis bonplandi,				Vérany.	
Cranchia reinhardtii,	[1850]			Stp.	
„ sp.,	Ch.				
Taonius pavo,			V.		
„ *hyperboreus*,	[1250] Ch.	P.			IV. VI.
„ *suhmi*, n. sp.,	Ch.				VII. (?).

TABLE II.—*Species recorded from between the Surface and 50 fathoms.*

Species.	Challenger.	Other British Expeditions.	American Expeditions.	Other Sources and Remarks.	Also in Table
Octopus occidentalis, n. sp.,	n. rec.				
„ *tuberculatus*,	32				III.
„ *verrucosus*, n. sp.,	shore.				
„ *granulatus*,	15–20				
„ *boscii*, var. *pallida*, n.,	38				IV.
„ *tonganus*, n. sp.,	reefs.				
„ *vitiensis*, n. sp.,	reefs.				
„ *marmoratus*, n. sp.,	reefs.				
„ *australis*, n. sp.,	6–15				
„ *tehuelchus*,	8				

TABLE II.—*continued.*

Species.	Challenger.	Other British Expeditions.	American Expeditions.	Other Sources and Remarks.	Also in Table
Octopus arcticus,			7–47		III. IV. V.
„ *verrilli*,			27		III.
„ *pictus*, var. *fasciata*, n.,	6–15				
„ *bermudensis*, n. sp.,				Exact depth not recorded.	
„ *bandensis*, n. sp.,					
Eledone cirrosa,		40		T.	
Inioteuthis morsei,	8				
Rossia oweni,		40		T.	III.
„ *hyatti*,			7–49		III.
„ *sublevis*,			42–45		III. IV.
„ (?) *tenera*,			18–31		III. IV.
Sepia smithi, n. sp.,	28				
„ *papuensis*, n. sp.,	28				
„ *elliptica*, n. sp.,	28–49				
„ *kobiensis*, n. sp.,	8				
„ *pfefferi*, n. sp.,	28				
Sepiella maindroni (?),	12				
Loligo pealei,			1–50		
„ *brasiliensis*,	13				
„ *kobiensis*, n. sp.,	8–12				
„ *indica*,	28				
„ *galatheæ*, n. sp.,	20				
Todarodes pacificus,	12				

TABLE III.—*Species recorded from between* 50 *and* 100 *fathoms.*

Species.	Challenger.	Other British Expeditions.	American Expeditions.	Other Sources and Remarks.	Also in Table
Octopus tuberculatus (?),			69–84		II.
„ *arcticus*,			54–97	60–300 S.	II. IV. V.
„ *verrilli*,			69		II.
Sepiola rondeleti,		60–80 P.			
Stoloteuthis leucoptera,			94		IV.
Rossia oweni,		60–80 P.			II.
„ *glaucopis*,				60 S.	IV.
„ *hyatti*,			57–101		II.
„ *sublevis*,	53		54–100	Not repeated in Table IV.	II. IV.
„ (?) *tenera*,	85		57–85		II. IV.
„ *patagonica*,	53				
Loligo ellipsura, n. sp.,	53				
Illex illecebrosus,			51–100		I. IV.

TABLE IV.—*Species recorded from between* 100 *and* 500 *fathoms.*

Species.	Challenger.	Other British Expeditions.	American Expeditions.	Other Sources and Remarks.	Also in Table
Cirroteuthis meangensis, n. sp.,	500				V.
Stauroteuthis syrtensis,			250		V. VI.
Opisthoteuthis agassizii,			291		VI.
Alloposus mollis,			238–506		I. V. VI.
Octopus hoscii, var. *pallida*, n.,	150				II.
„ *areolatus*,	140				
„ *carolinensis*,			142		
„ *duplex*, n. sp.,	150				
„ *lentus*,			120–464		V.
„ *obscus*,			150–300		
„ *piscatorum*,			120–200		V. VI.
„ *arcticus*,		345 P.	101–487	600–300 S.	II. III. V.
„ *januarii*, n. sp.,	350				VI.
Eledone verrucosa,			466		V. VI.
Stoloteuthis leucoptera,			110–388		III.
Nectoteuthis pourtalesii,			180		
Rossia glaucopis,		345 P.		200 S.	III.
„ *sublevis*,			101–458		II. III.
„ *brachyura*,			208		
„ *tenera*,			100–252		II. III.
„ *megaptera*,			150		V.
Spirula peronii,	360				V.
Sepia cultrata, n. sp.,	150				
„ *sulcata*, n. sp.,	140				
„ *kiensis*, n. sp.,	140				
Illex illecebrosus,			100–258		I. III.
Abralia megalops,			137–173		
Gonatus fabricii,			255–372		I. V.
Chiroteuthis lacertosa,			306–464		VI. VII.
Brachioteuthis beanii,			183–368		V.
Calliteuthis reversa,	345		365		V. VI. VII.
Histioteuthis collinsii,			180–372		
Taonius hyperboreus,			[388]		VI.
Nautilus pompilius,	315				

TABLE V.—*Species recorded from between* 500 *and* 1000 *fathoms.*

Species.	Challenger.	Other British Expeditions.	American Expeditions.	Other Sources and Remarks.	Also in Table
Cirroteuthis meangensis, n. sp.,	600				IV.
Stauroteuthis syrtensis,			523		IV. VI.
Amphitretus pelagicus, n. sp.,	[520]			Almost certainly from the surface.	
Alloposus mollis,			715		I. IV. VI.

TABLE V.—*continued.*

Species.	Challenger.	Other British Expeditions.	American Expeditions.	Other Sources and Remarks.	Also in Table
Octopus lentus,			603		IV.
„ *piscatorum*,		540, 608		K.E., T.	IV. VI.
„ *arcticus*,		540–632	524, 843	P., K.E., T.	II. III. IV.
Eledone verrucosa,	630		787–810		IV. VI.
„ *brevis*, n. sp.,	600				
Japetella prismatica, n. sp.,	[770]			Probably from surface.	
Rossia megaptera,			640		IV.
Spirula peronii,			950		IV.
Bathyteuthis megalops,			600		VI.
Mastigoteuthis agassizii,			647		VI. VII.
Ancistrocheirus megaptera,			707		
Gonatus fabricii,			715, 906		I. IV.
Brachioteuthis beanii,			843		IV.
Calliteuthis reversa,			906		IV. VI. VII.

TABLE VI.—*Species recorded from between* 1000 *and* 2000 *fathoms.*

Species.	Challenger.	Other British Expeditions.	American Expeditions.	Other Sources and Remarks.	Also in Table
Cirroteuthis magna, n. sp.,	1375				VII.
„ *plena*,			1073		
„ *megaptera*,			1054		VII.
Stauroteuthis syrtensis,			1346		IV. V.
Opisthoteuthis agassizii,			1054		IV.
Alloposus mollis,			1346–1735		I. IV. V.
Octopus piscatorum,			1362		IV. V.
„ *gracilis*,			1290		
„ *januarii*, n. sp.,	1875				IV.
Eledone verrucosa,			1050–1255		IV. V.
Eledone rotunda, n. sp.,	1950				VII.
Eledonella diaphana, n. sp.,	[1100]			Quite uncertain.	
Promachoteuthis megaptera, n. sp.,	1875			Very doubtful.	VII.
Enoploteuthis margaritifera,	[1425]				
Bathyteuthis abyssicola, n. sp.,	1600		1073		V.
„ *megalops*,			1632		V. VII.
Mastigoteuthis agassizii,	1945		[1731]	Probably surface.	
Doratopsis diaphana,			1022, 1309		IV. VII.
Chiroteuthis lacertosa,			1346–1608		IV. V. VIII.
Calliteuthis reversa,				Surface almost beyond doubt.	
Cranchia reinhardtii,	[1850]				
Taonius hyperboreus,	[1250]		[1346]	Almost certainly surface.	I. IV.

TABLE VII.—*Species recorded from between* 2000 *and* 3000 *fathoms.*

Species.	Challenger.	Other British Expeditions.	American Expeditions.	Other Sources and Remarks.	Also in Table
Cirroteuthis magna, n. sp.,	2225				VI.
,, *pacifica*, n. sp.,	2440				
,, *megaptera*,			2512, 2574		VI.
Eledone rotunda, n. sp.,	2225				VI.
Eledonella pygmæa,			[2949]		
Mastigoteuthis agassizii,			2515		V. VI.
Enoploteuthis margaritifera,	[2425]			Very doubtful.	VI.
Chiroteuthis lacertosa,			2098, 2949		IV. VI.
Calliteuthis reversa,			2369		IV. V. VI.
Histiopsis atlantica, n. sp.,	2025			Possibly surface.	
Taonius suhmi, n. sp.,	[2150]			Surface.	I.

Some of the genera enumerated in the above list merit a brief discussion, and among these perhaps the most interesting is *Cirroteuthis*, whose remarkable history has already been alluded to (p. 55); the type species, described in 1836, was the only one known till 1883, since which time six species have been brought to our knowledge in addition to the two closely allied if not identical genera, *Stauroteuthis* and *Opisthoteuthis*. The following table gives all the particulars which have been published regarding the habitat of each of these forms, as well as the localities of some specimens too fragmentary for identification.

Species.	Locality.	Depth in Fathoms.	Temperature.		Remarks.
			Bottom ° F.	Surface ° F.	
Cirroteuthis müllèri, Eschricht,	Jakobshavn, Greenland.	...	...	...	No information as to depth.
,, *umbellata*, Fischer,	Off Azores and West Coast of Africa.	616 to 1206	...	...	
,, *magna*, Hoyle,	Southern Ocean.	1375	35·6	43·0	
,, ,,	Off Valparaiso.	2225	35·6	59·0	
,, *pacifica*, Hoyle,	Between Papua and Australia.	2440	35·8	80·0	Station Book says "surface."
,, *meangensis*, Hoyle,	Off Meangis Islands, North of New Guinea.	500	41·8	80·5	
,, ,,	Off Kermadec Islands, South Pacific.	600	39·5	66·5	
,, sp.?,	20° West of Patagonia.	...	...	...	Floating on surface, dead and mutilated.
,, *plena*, Verrill,	5' East of Chesapeake Bay.	1073	38·0	73·0	
,, *megaptera*, Verrill,	A little further east.	2512	37·0	78·0	Two specimens.
,, ,,	A little further east still.	2574	37·0	79·0	,, ,,
,, sp.?,	A little further north.	1054	38·0	74·0	
,, eggs of,	More than six localities in the same region.	428 to 1106	38·0 to 40·0	71·0 to 74·0	
Stauroteuthis syrtensis, Verrill,	30 miles east of Sable Island, Nova Scotia.	250	...	...	
	Off Martha's Vineyard.	523	39·0	68·0	
	Near same locality.	1346	...	...	
Opisthoteuthis agassizii, Verrill,	Off Grenada.	291	...	...	
	Off Martha's Vineyard.	1058	38·0	74·0	

From the above table it will be seen that (excluding the type form, concerning which no information has been published in this regard), not one of the species of *Cirroteuthis* has been found at a depth less than 600 fathoms, and, therefore, if we are justified in taking the depth to which the dredge or trawl descended as representing the depth from which the specimens were obtained, we must certainly regard them as deep-sea forms.

It is, however, well known to all who are familiar with the methods of deep-sea dredging that this cannot be at once assumed. Indeed, in one case, namely that of *Cirroteuthis pacifica*, the MS. Station Book kept on board the Challenger states that the specimen came from the surface, but it appears certain that this was merely an assumption based upon the supposed nature of the animal, and cannot be held as conclusive evidence in regard to the occurrence of these animals on the surface.

On the other hand, it is not a little noticeable that this family should have remained among the greatest of zoological rarities until deep-sea dredging was practised, and that then specimens should have been procured with comparative frequency. Negative evidence is proverbially unsatisfactory, but had they been surface organisms one would have expected that the voyages of the older zoologists would have shown us some trace of creatures which are too remarkable to have been passed over in silence had they been observed.

The fact that the animals in question should have been so long known from one locality in the Arctic regions is probably to be explained, as v. Willemoes-Suhm has hinted, by this being one more instance of a type found in the abyssal regions near the equator and in temperate regions of the globe, whilst it approaches near to the surface in the Polar regions (see p. 65). The probability that this hypothesis is correct is increased by a consideration of the temperatures of the various localities at which the specimens were found; a glance at the table shows that while the surface temperature in these various places varied as much as from 43° to 80° F., the bottom temperature was comparatively constant, ranging between 35°·6 and 41°·8 F.

Furthermore, eggs containing embryos undoubtedly belonging to this genus have been dredged by Professor Verrill in deep water, 428 to 1106 fathoms, and it would seem unreasonable to suppose that animals living at the surface should lay eggs and leave them to sink through so great a distance, during which time they would be exposed to great danger from the attacks of their enemies.

The two other genera discovered by Professor Verrill do not seem to be so certainly deep-sea animals as *Cirroteuthis*, for they have both been met with at depths of less than 300 fathoms, although they appear also to range to a depth of over 1000 fathoms.

In discussing this matter it must not be forgotten that there are animals with a very extensive bathymetrical range, *e.g.*, *Amphilepis norvegica*, among the Ophiuroidea, and *Bathyactis symmetrica* among the Corals, but these are exceptions, and from the reasons

detailed above, I am inclined to think that the Cirroteuthidæ belong to the deep-water rather than to the shallow seas.

As regards their habits we are quite in the dark. Reinhardt and Prosch in their treatise upon *Cirroteuthis mülleri* confessed their entire ignorance of this matter, and though they held out the hope that Dr. Rudolph would do something to enlighten the scientific world on this head, still the darkness remains as great as ever—whether the huge umbrella serves only for swimming, or whether it is also a kind of fishing net; what is the function of the cirri between the suckers? are they tactile like the long fringes of certain deep-sea fish? or do they serve to create a current sweeping particles of food to the mouth as already suggested (p. 56)? Even as regards the food of *Cirroteuthis* I can give no information, for all the specimens in the Challenger collection were either so fragmentary that it was impossible to examine their stomachs, or else these were empty. The intestine of *Cirroteuthis magna* contained a mass of pulpy material in which I found no recognisable fragments.

Another genus, which there is reason to regard as an inhabitant of the deep sea, is *Bathyteuthis*, the type specimen of which was dredged by the Challenger in the Southern Ocean, north-west of Kerguelen, from a depth of 1600 fathoms; and quite recently Professor Verrill has described, under the name *Benthoteuthis*, two other specimens from 600 and 1073 fathoms in the North Atlantic, obviously belonging to the same genus.[1] In the course of his description he calls attention to the embryonic characters of these animals, which indeed are too striking to escape notice, but these same characters may also point to the deep sea as the probable home of the species.

For the small fins seem but ill adapted for a pelagic life, and the minuteness of the suckers with which the arms and tentacles are provided seem little fitted for raptorial purposes, while the great size of the eyes is known to be a character of frequent occurrence in deep-sea animals, in addition to which the large buccal membrane may serve the purpose of collecting food from an oozy bottom.

A third genus which may perhaps be abyssal is *Mastigoteuthis*, Verrill, of which at present only one species is known, *Mastigoteuthis agassizii*, which has been dredged by the U.S.S. "Blake" and by the Fish Commission in depths varying from 647 to 2516 fathoms, while the Challenger brought home a single tentacle which adhered to the dredge-rope at Station 2 in the eastern part of the North Atlantic, where the depth was 1945 fathoms.

It will be seen that this species presents a great contrast to the last mentioned in the fin, which is exceedingly large, quite as large as in any of the pelagic forms; this would seem to indicate that although the animal may dwell in the deep sea, it by no means leads a sedentary existence; the two genera resemble each other, however, in the form of the tentacles, which are long, cylindrical and taper to points at the extremities instead of

[1] *Trans. Connect. Acad.*, vol. vi. pp. 401–403, 1885.

expanding to form clubs, and are armed with very minute suckers; I have not observed anything like a specialised tactile organ in either of these tentacles, or I should be disposed to suggest an analogy between them and the long streaming fringes found in certain deep-sea fish. The fact remains, however, that this form of tentacle is the only structural character which I have observed to be common to any two deep-sea Cephalopods. The stomach of one of Professor Verrill's specimens contained fragments of Crustacea, but we have no other information regarding its habits and mode of life.

It must be admitted that the evidence that this form came from the deep sea is by no means conclusive, but it is very suggestive that no individuals should have been taken in a surface net, while they seem to be not very uncommonly brought up by the deep-sea trawl.

Five species of *Octopus* (see p. 229), have been brought up from depths of over 500 fathoms, a particularly interesting fact since we are accustomed to consider these animals as being characteristic of shallow waters. It seems unlikely, however, that they live at the surface, for from what we know of the habits of this genus as observed in aquaria, they seem rather to frequent the bottom, hiding in crevices of the rocks, and clinging to them by their suckers, swimming only as a means of passing from one hiding place to another; the same remark applies also to the three species of *Eledone* (*Eledone verrucosa*, *Eledone rotunda* and *Eledone brevis*), which also appear in the lists of deep-water forms.

Eledonella has only been twice obtained and on both occasions by a dredge that had been down to the abyssal regions (1100 and 2949 fathoms), but its semitransparent consistency, resembling that of *Cranchia* and *Taonius*, is suggestive of its being a pelagic organism.

Alloposus mollis furnishes another problem for future investigation, both as regards its habits and its systematic position. All the specimens obtained in a perfect state have been brought up from considerable depths, and the tissues have a soft gelatinous character, recalling *Cirroteuthis*; perhaps this may be in some way correlated with deep-sea life; Günther has pointed out that abyssal fish when brought up to the surface present a marked flaccidity of their tissues.

As regards the single specimen which forms the type of the new genus *Promachoteuthis*, I feel quite unable to give any opinion as to its habits. It was brought up by the deep-sea trawl from a depth of 1875 fathoms, off the coast of Japan, but I have failed to find any sufficient evidence to show whether it came from the surface or the bottom.

The Taonoteuthids (*Calliteuthis*, *Histioteuthis*, &c.) form a group, whose bathymetrical distribution presents a still unsolved problem; perhaps the truth is that the species vary in this respect. Vérany records that his specimens of *Histioteuthis* were taken by the dredge; *Calliteuthis* has been taken by deep-sea dredges in depths varying from 345 to 2369 fathoms; the only specimen known of *Histiopsis* was brought up by a trawl which

had descended to 2025 fathoms. On the other hand, *Chiroteuthis veranyi* is distinctly stated by Vérany to live "à fleur d'eau pendant les calmes des belles saisons, au milieu des médusaires,"[1] and the same author records that he also found his specimen of *Chiroteuthis bonplandi* on the surface, while Verrill's examples of *Chiroteuthis lacertosa* have been obtained by dredging, apparently from depths varying from 300 to 2900 fathoms.

In this, as in so many other respects, we must await new facts before any conclusions of value can be obtained; the great need of the present day as regards inquiry into bathymetrical distribution is a net which can be opened and closed at any given depth.

[1] Céph. médit., p. 122.

SUMMARY.

The present Report opens with a synopsis of all the recent species of Cephalopods; no pains have been spared to ensure accuracy and completeness in this part of the work, and it is hoped that it will enable the memoir to serve to some extent as a monograph of the group, for though the space available precluded the possibility of adding diagnoses of genera and species, references have been given to the works where these may be obtained.

A list of the species contained in the Challenger collection occupies the next section of the Report, diagnoses of the new ones being given and such remarks as seemed necessary on those previously known. The Challenger collection contains 72 species, disposed in 30 genera, of which 32 species and 4 genera are described as new to science; it has only been found necessary, however, to create one new family (Amphitretidæ).

The "Porcupine," "Knight Errant," "Triton," and "Valorous" collections, which, as explained in the Introduction, are included in this memoir, contain 8 additional species, none of which are new, and 3 additional genera, making a total of 80 species and 33 genera recorded.

It is a matter for surprise that so few pelagic Cephalopods should have been captured on an expedition which spent so much time on the open ocean, and made such constant and systematic use of the townet. The explanation probably lies in the enormous activity of these animals, which is so great that they can only be captured when the vessel is moving rapidly, a condition which renders the use of the townet difficult if not impossible.

A most important means of obtaining them is by the examination of the stomachs of predaceous birds, fish and Cetacea, of whose food they form a large part; on the Challenger Expedition, for example, several specimens of *Ommastrephes oualaniensis* were taken from the stomach of a bird which alighted on the ship; and one of the most remarkable items in the collection, the large pen described on p. 178, was taken from the stomach of a shark. The value of the results which would accrue to science if whalers and those engaged in the capture of sea-fowl would preserve the contents of the stomachs in spirit, can hardly be exaggerated.

Some disappointment may be felt at there being no specimen, even fragmentary, of one of those giant squids (*Architeuthus*), which have been found, attaining sometimes a

length of sixty or seventy feet,[1] in all parts of the world, and which have, no doubt, contributed to the stories of the sea-serpent. The largest Cephalopod obtained by the Challenger was the type of *Cirroteuthis magna;* it measures more than a metre in length, and is interesting as being the largest individual of the genus which has yet been obtained.

The greatest accessions of new species have been to the already large genera *Octopus*, *Sepia*, and *Loligo*, but these are of less interest than the unique specimens which have been made types of new genera, each of which presents some character either entirely novel, or important as furnishing connecting links between previously known forms. The genus *Amphitretus*, for example, has two openings into the branchial cavity in place of one, a disposition found in no other Cephalopod; while *Histiopsis* is related closely to *Histioteuthis*, *Chiroteuthis*, and *Calliteuthis*.

The next section treats of Geographical Distribution, and an attempt has been made to supplement the work of the Challenger by a summary of all that has been recorded on this head. The species have been divided into "littoral" and "oceanic," the latter group including both "pelagic" and "abyssal." Lists of each of these are given, but owing probably to the want of complete information, the same species sometimes appears under two categories; thus an *Ommastrephes*, typically pelagic, may be obtained near the coast among littoral forms. It is much to be wished that future collectors will carefully note the exact localities where and the conditions under which specimens are obtained, and thus help to unravel some of the problems which wait solution regarding the distribution of these animals.

In the concluding section, which treats of Bathymetrical Distribution, still greater difficulties have been encountered, because in the case of such active creatures it is obviously impossible to assume that they were captured by the dredge or trawl at the greatest depth reached. In the case of the single specimen of *Promachoteuthis*, for example, there seems no means of arriving at any conclusion as to the depth whence it was obtained.

Nevertheless, taking all collateral facts into consideration, evidence is adduced which seems to indicate that *Cirroteuthis* almost certainly, *Bathyteuthis* and *Mastigoteuthis* probably, and possibly even one or two species of *Octopus*, may be veritably abyssal Cephalopods, but apart from the single fact that *Bathyteuthis* and *Mastigoteuthis* both have slender filiform tentacles with minute suckers, no structural features have been discovered which will serve to diagnose a deep-sea form from a shallow-water one.

[1] Verrill, Ceph. N.E. Amer., part i.

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Note.—Synonyms are printed in *italics*; the more important pages are indicated by darker type.

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EXPLANATION OF PLATES.

The figures of the animals have been drawn upon the stone under my supervision by Messrs. J. Reekie and A. Pollock, to whom I am indebted for the pains they have taken to carry out my wishes. Most of the details of tentacles, suckers, &c., have been copied from my own drawings, made with the assistance of the camera. For drawings of some species I am indebted to Professor Steenstrup, as is indicated on the plates where they are figured.

PLATE I.

PLATE I.

PAGE

OCTOPUS BOSCII (Lesueur), var. PALLIDA, nov., 81

Fig. 1. Lateral view of the animal; the larger specimen somewhat reduced.

Fig. 2. Portion of the dorsal surface, to show the multifid papillæ; magnified about 2 diameters.

Fig. 3. A large cirrus from the back; magnified 2 diameters.

Fig. 4. The dorsal mandible; natural size.

Fig. 5. The ventral mandible; natural size.

OCTOPUS BOSCII var PALLIDA, nov

PLATE II.

PLATE II.

PAGE

Figs. 1–4. OCTOPUS LEVIS, n. sp., 98

Fig. 1. Dorsal view of the largest specimen; natural size.

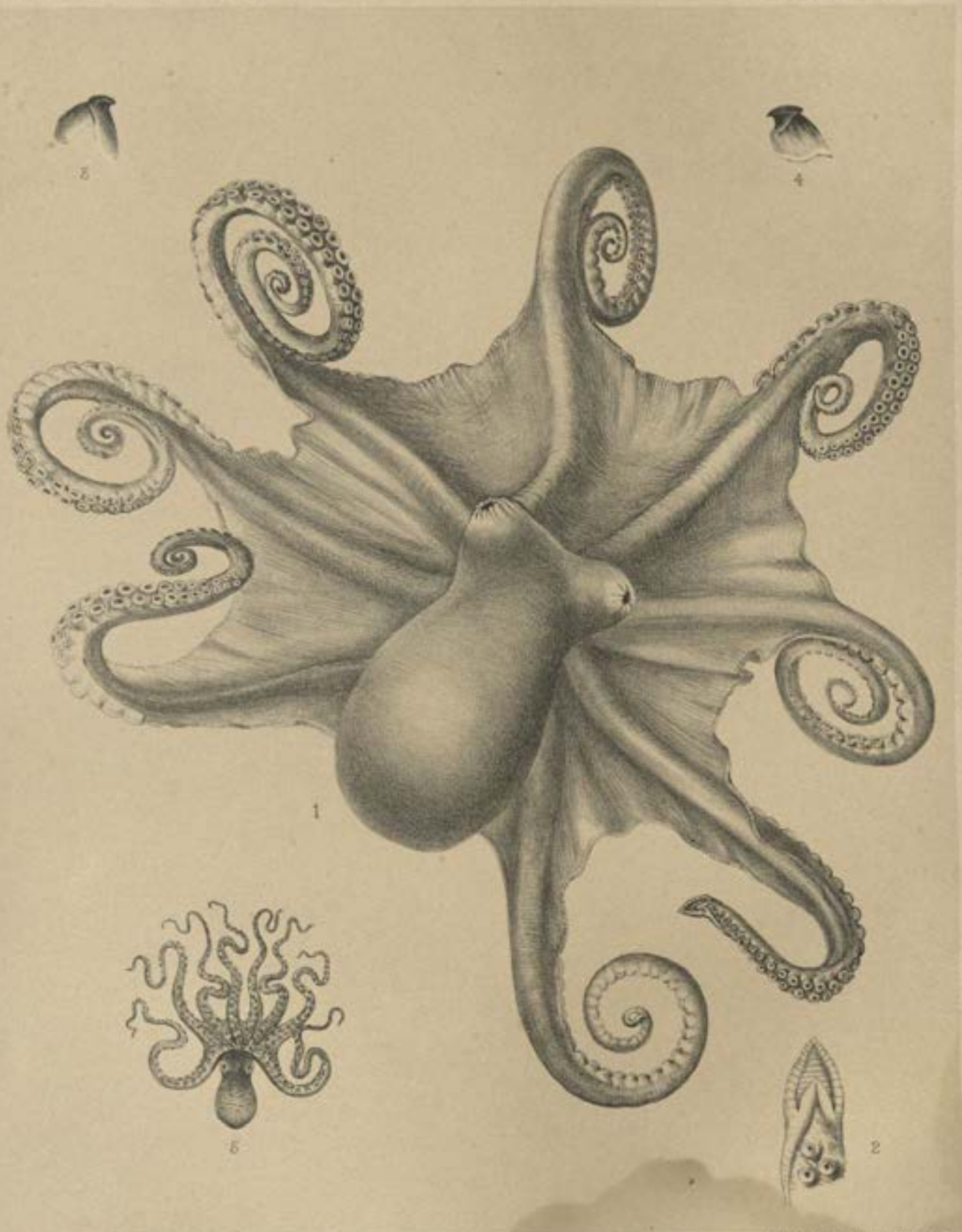
Fig. 2. Extremity of the hectocotylised arm; magnified 3 diameters.

Fig. 3. The ventral mandible; natural size.

Fig. 4. The dorsal mandible; natural size.

Fig. 5. OCTOPUS BERMUDENSIS, n. sp., 94

Fig. 5. Dorsal view of the specimen; natural size.



1-4. OCTOPUS LEVIS, n. sp. 5. OCTOPUS BERMUDENSIS, n. sp.

PLATE III.

PLATE III.

PAGE

Fig. 1. OCTOPUS LEVIS, n. sp., 98

Fig. 1. Inner side of umbrella, showing the circumoral lip and the hectocotylised arm; natural size.

Fig. 2. OCTOPUS BOSCII (Lesueur), var. PALLIDA, nov., 81

Fig. 2. View of the inner surface of the umbrella, showing the circumoral lip and the supernumerary sucker.

Figs. 4, 5. OCTOPUS AUSTRALIS, n. sp., ... 88

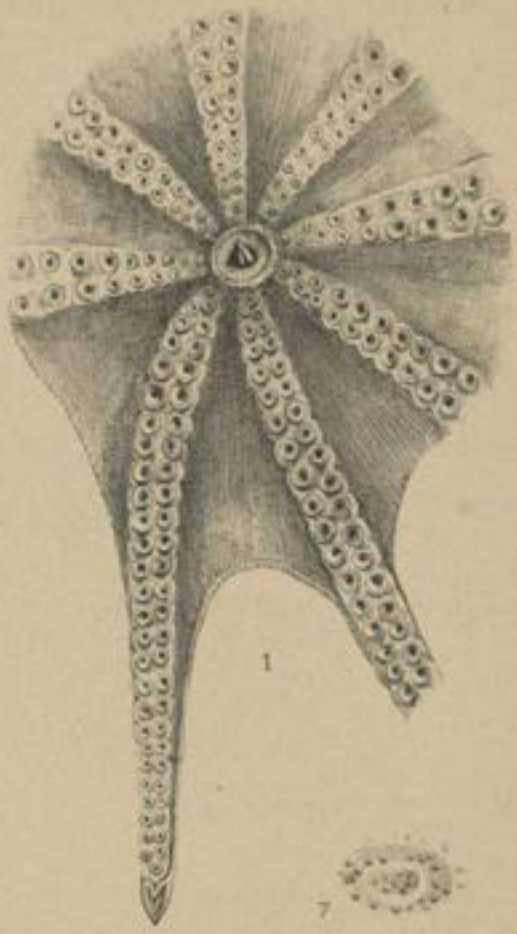
Fig. 4. Dorsal view of the larger specimen; natural size.

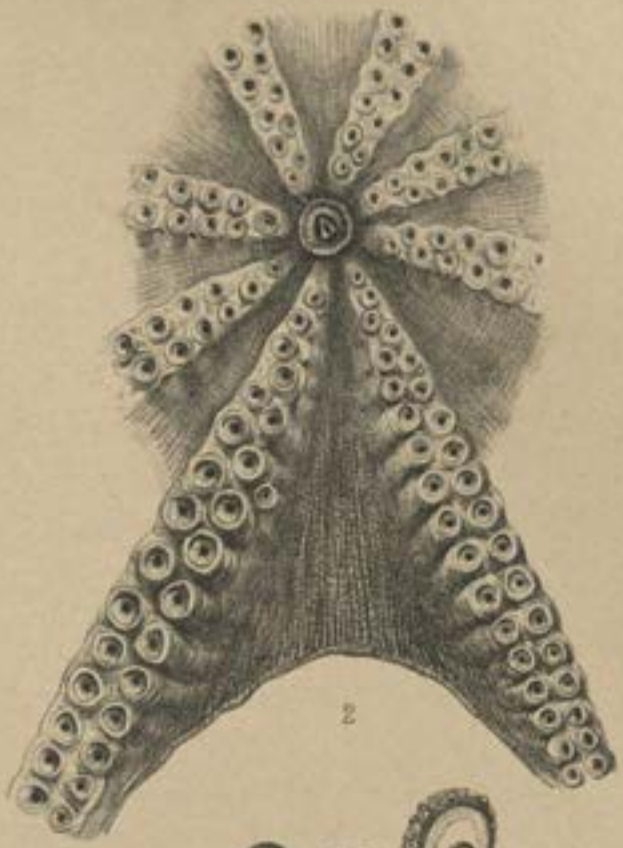
Fig. 5. Ventral aspect, showing the raised ridges along either side of the mantle.

Figs. 6, 7. OCTOPUS AREOLATUS, de Haan, ... 86

Fig. 6. Lateral view of the Challenger specimen; natural size.

Fig. 7. The "ocellus" or eye-like spot, and some of the cutaneous warts, drawn from a specimen in the Copenhagen Museum; natural size.





1, OCTOPUS LEVIS, n. sp. 2, OCTOPUS BOSCII, var PALLIDA nov.

4, 5, OCTOPUS AUSTRALIS, n. sp. 6, 7, OCTOPUS AREOLATUS, de Haan.

PLATE IV.

PLATE IV.

PAGE

OCTOPUS VERRUCOSUS, n. sp., 79

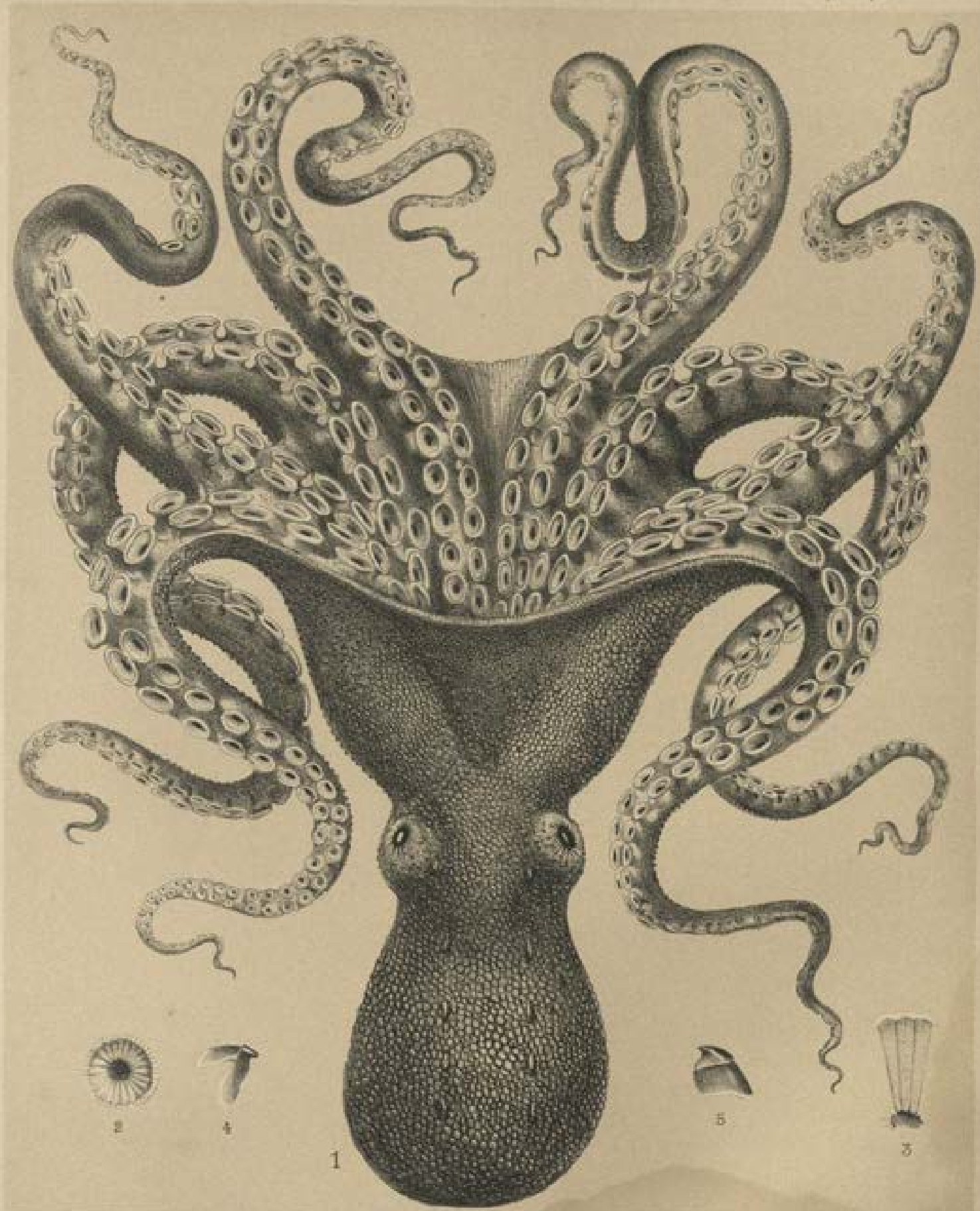
Fig. 1. Dorsal view of the animal; somewhat reduced.

Fig. 2. One of the suckers; natural size.

Fig. 3. Portion of a sucker, showing its radial grooves and rugose surface.

Fig. 4. The ventral mandible; natural size.

Fig. 5. The dorsal mandible; natural size.



H.T. Carlson & Erskine, Lith.rs Edinr.

OCTOPUS VERRUCOSUS, n. sp.

PLATE V.

PLATE V.

PAGE

OCTOPUS PUNCTATUS, Gabb.,[1] . . . 100

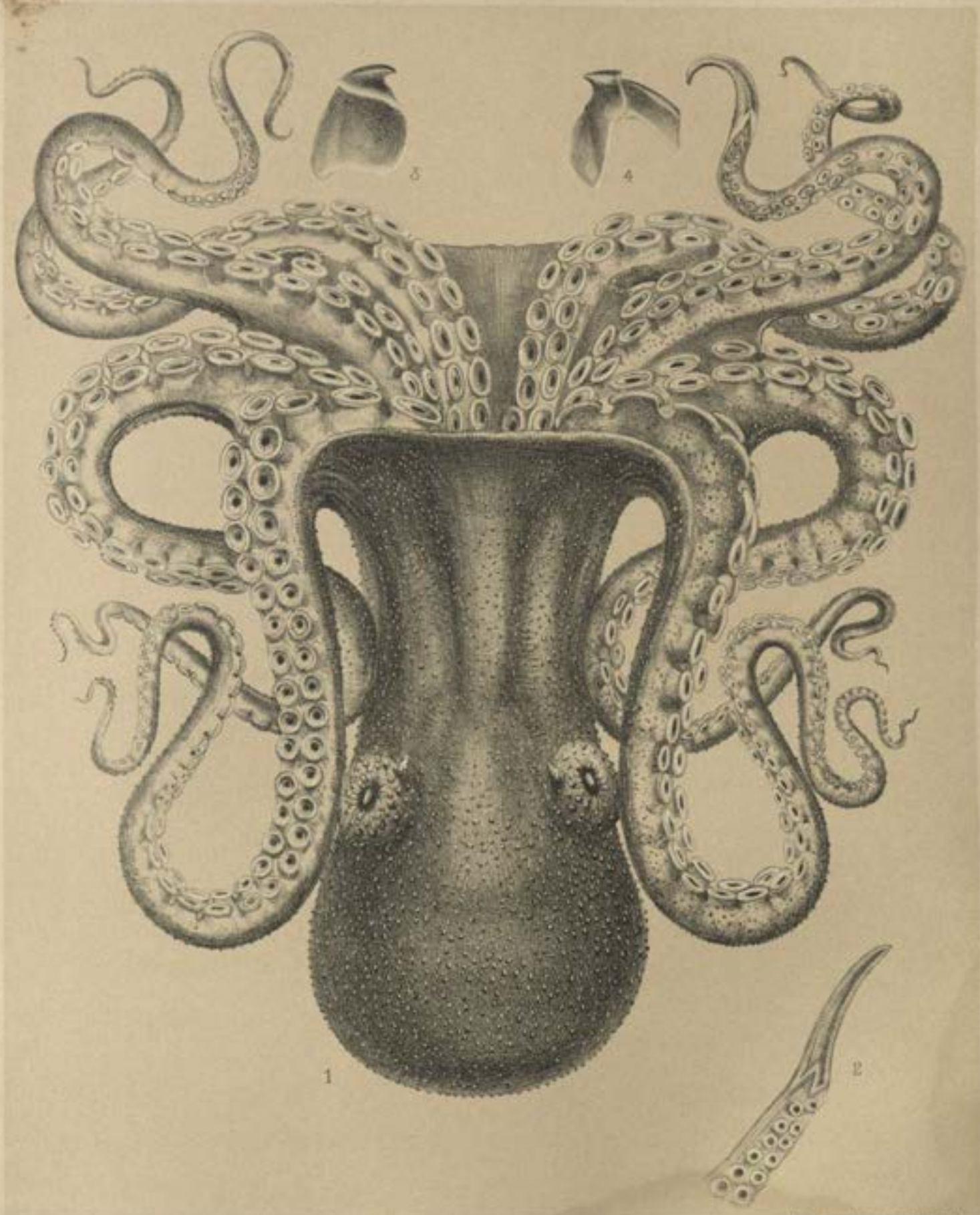
Fig. 1. Dorsal view of the animal; somewhat reduced.

Fig. 2. The extremity of the hectocotylised arm; natural size.

Fig. 3. The dorsal mandible; natural size.

Fig. 4. The ventral mandible; natural size.

[1] The name has been changed since the plate was printed off.



Mc Farlane & Erskine, Lith^rs Edin^r

OCTOPUS HONGKONGENSIS, Sp.

PLATE VI.

PLATE VI.

PAGE

OCTOPUS MARMORATUS, n. sp., . . . 85

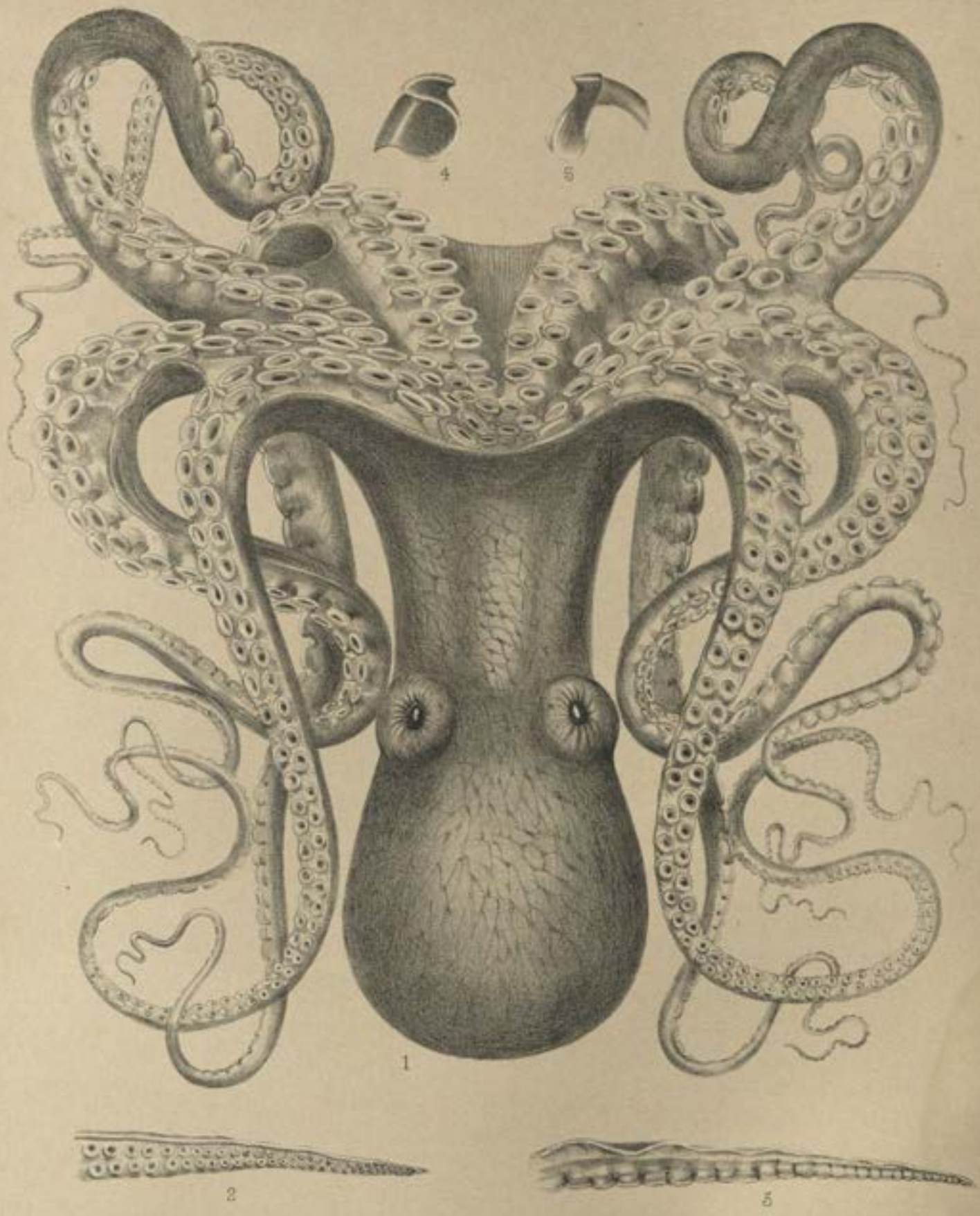
Fig. 1. Dorsal view of one of the female specimens; slightly reduced.

Fig. 2. Inner aspect of the extremity of the hectocotylised arm; natural size.

Fig. 3. Ventral aspect of the same arm; natural size.

Fig. 4. Dorsal mandible; natural size.

Fig. 5. Ventral mandible; natural size.



OCTOPUS MARMORATUS, n. sp.

PLATE VII.

PLATE VII.

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Figs. 1–4. OCTOPUS JANUARII; Steenstrup, 97

Fig. 1. Lateral view of the larger specimen; natural size.

Fig. 2. Extremity of the hectocotylised arm; somewhat enlarged.

Fig. 3. The dorsal mandible; natural size.

Fig. 4. The ventral mandible; natural size.

Fig. 5. OCTOPUS DUPLEX, n. sp., . . . 90

Fig. 5. Dorsal view of the specimen; natural size.

Figs. 6–8. OCTOPUS VITIENSIS, n. sp., ... 84

Fig. 6. Dorsal view of the specimen; somewhat enlarged.

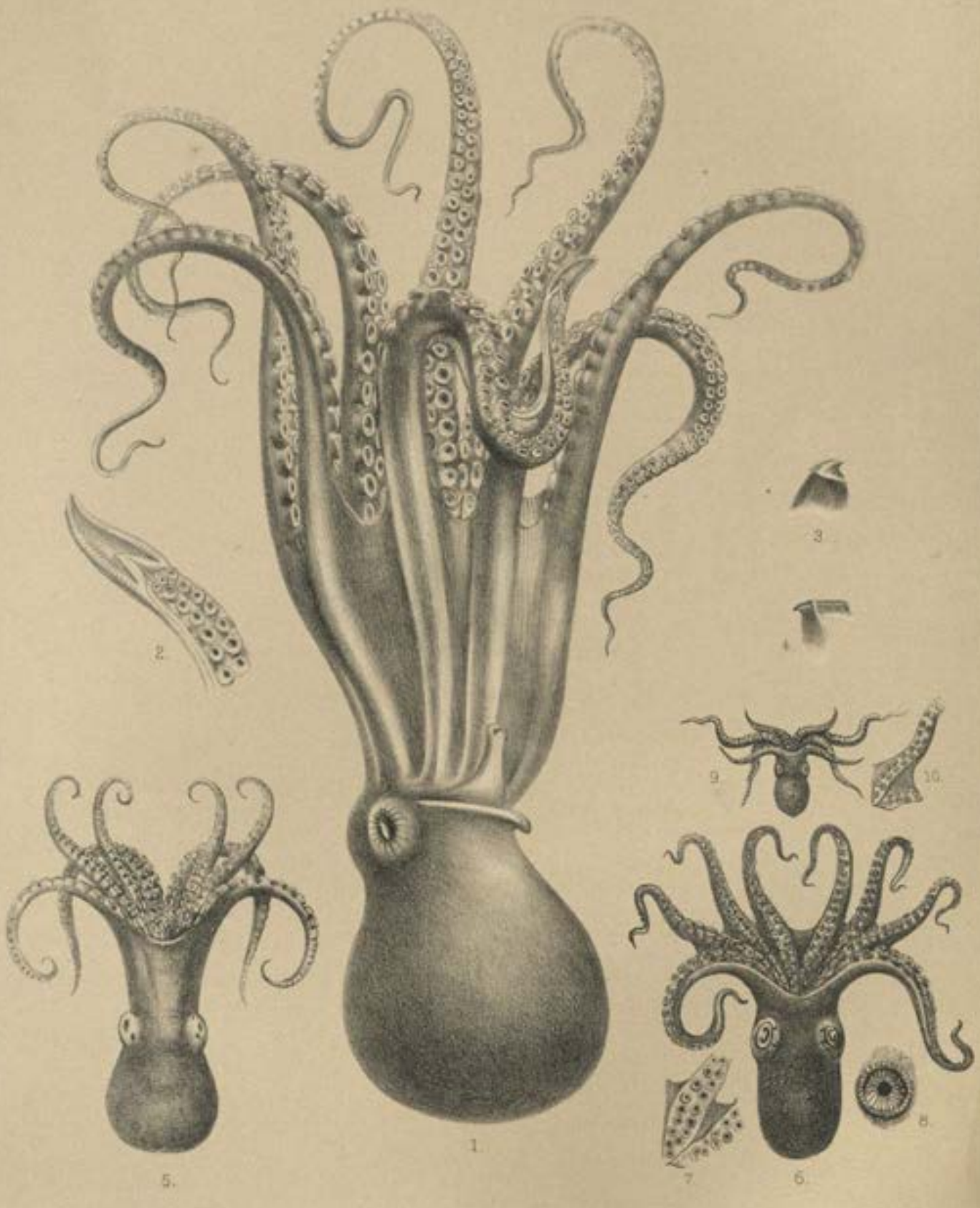
Fig. 7. Adoral portion of two of the arms.

Fig. 8. A sucker, to show its papillate margin and the rugose nature of the integument surrounding it; magnified 6 diameters.

Figs. 9, 10. OCTOPUS BANDENSIS, n. sp., . . . 96

Fig. 9. Dorsal view of the specimen, slightly enlarged.

Fig. 10. Adoral portion of two of the arms, somewhat enlarged; the four proximal suckers should have been represented in a single series.



1-4. OCTOPUS JANUARII, Stp.
6-8. OCTOPUS VITIENSIS, n. sp.
5. OCTOPUS DUPLEX, n. sp.
9, 10. OCTOPUS BANDENSIS, n. sp.

PLATE VIII.

PLATE VIII.

PAGE

Figs. 1, 2. OCTOPUS TONGANUS, n. sp., . . . 83

Fig. 1. Lateral view of the animal; natural size.

Fig. 2. Extremity of the hectocotylised arm; magnified 4 diameters.

Fig. 3. OCTOPUS PICTUS, Brock, var. FASCIATA, nov., . . 94

Fig. 3. Lateral view of the specimen; natural size.

Figs. 4–6. ELEDONE ROTUNDA, n. sp., . . . 104

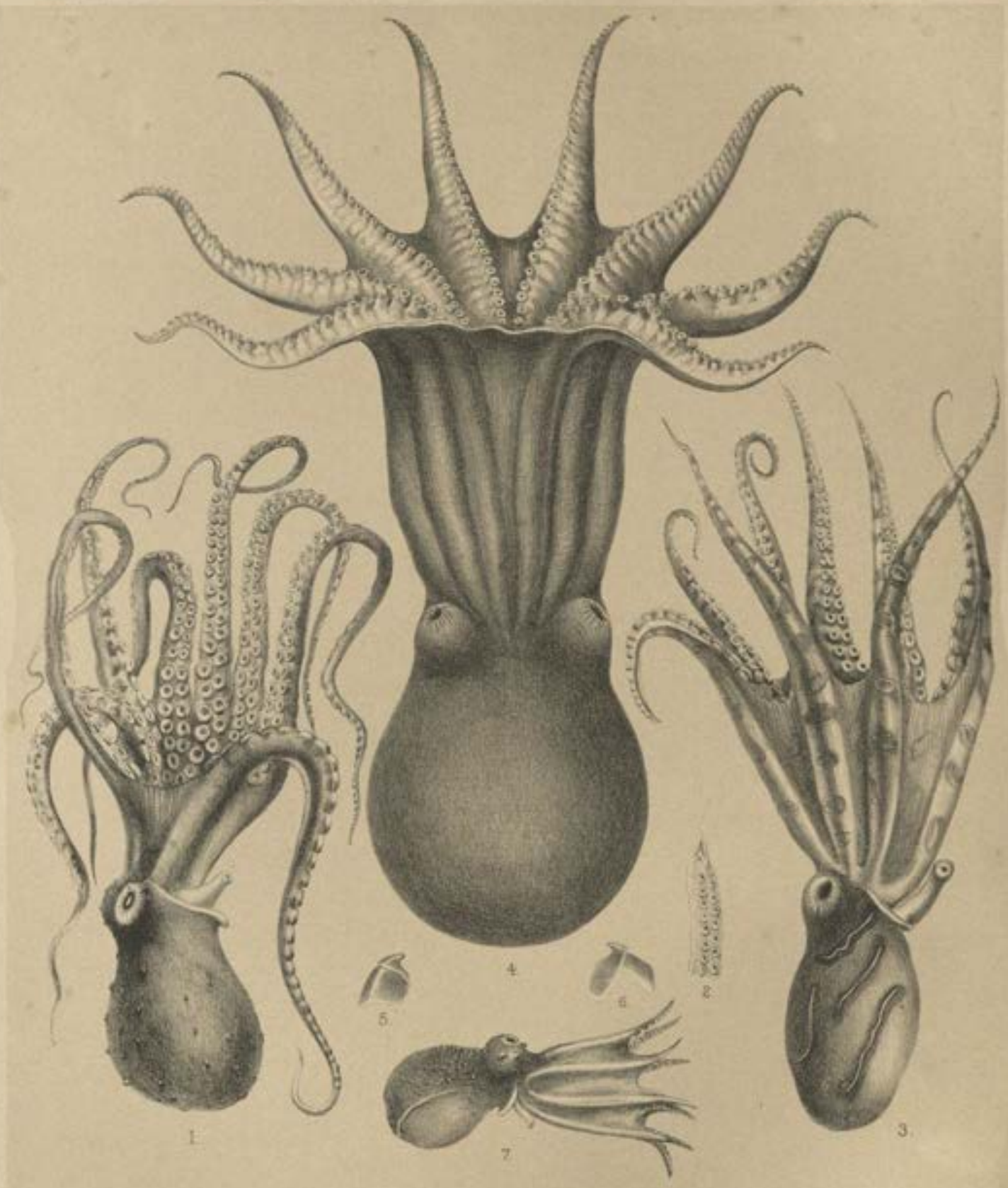
Fig. 4. Dorsal view of the animal; natural size.

Fig. 5. Dorsal mandible; natural size.

Fig. 6. Ventral mandible; natural size.

Fig. 7. ELEDONE BREVIS, n. sp., . . . 105

Fig. 7. Lateral view of the largest specimen; natural size. By an error of the draughtsman two of the cirri have been shown below the eye instead of above it.



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1, 2, OCTOPUS TONGANUS, n. sp.

3, OCTOPUS PICTUS, Brock, var. FASCIATA, nov.

4–6, ELEDONE ROTUNDA, n. sp.

7, ELEDONE BREVIS, n. sp.

PLATE IX.

PLATE IX.

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Figs. 1, 2. JAPETELLA PRISMATICA, n. gen., n. sp., . . 109

Fig. 1. Ventral aspect of the specimen; natural size.

Fig. 2. Dorsal aspect; natural size.

Figs. 3–6. ELEDONELLA DIAPHANA, n. sp., . . 107

Fig. 3. Ventral aspect of the specimen; magnified 2 diameters.

Fig. 4. Ventral aspect, with the mantle divided a little to the left of the middle line, and reflected to show the median septum, the arrangement of the gills, &c.; magnified 2 diameters.

Fig. 5. View of the arms and umbrella from the front; magnified 1·5 diameters.

Fig. 6. Portion of an arm with five suckers, showing the prismatic form which they have assumed; enlarged.

Figs. 7 9. AMPHITRETUS PELAGICUS, n. gen., n. sp., . . 67

Fig. 7. Lateral view of the animal; magnified 2 diameters.

Fig. 8. Ventral view of one of the arms and of the mouth, the proximal suckers are somewhat too close; magnified nearly 2 diameters.

Fig. 9. Tip of one of the arms magnified about 4 diameters.

Figs. 10, 11. CIRROTEUTHIS sp., . . . 66

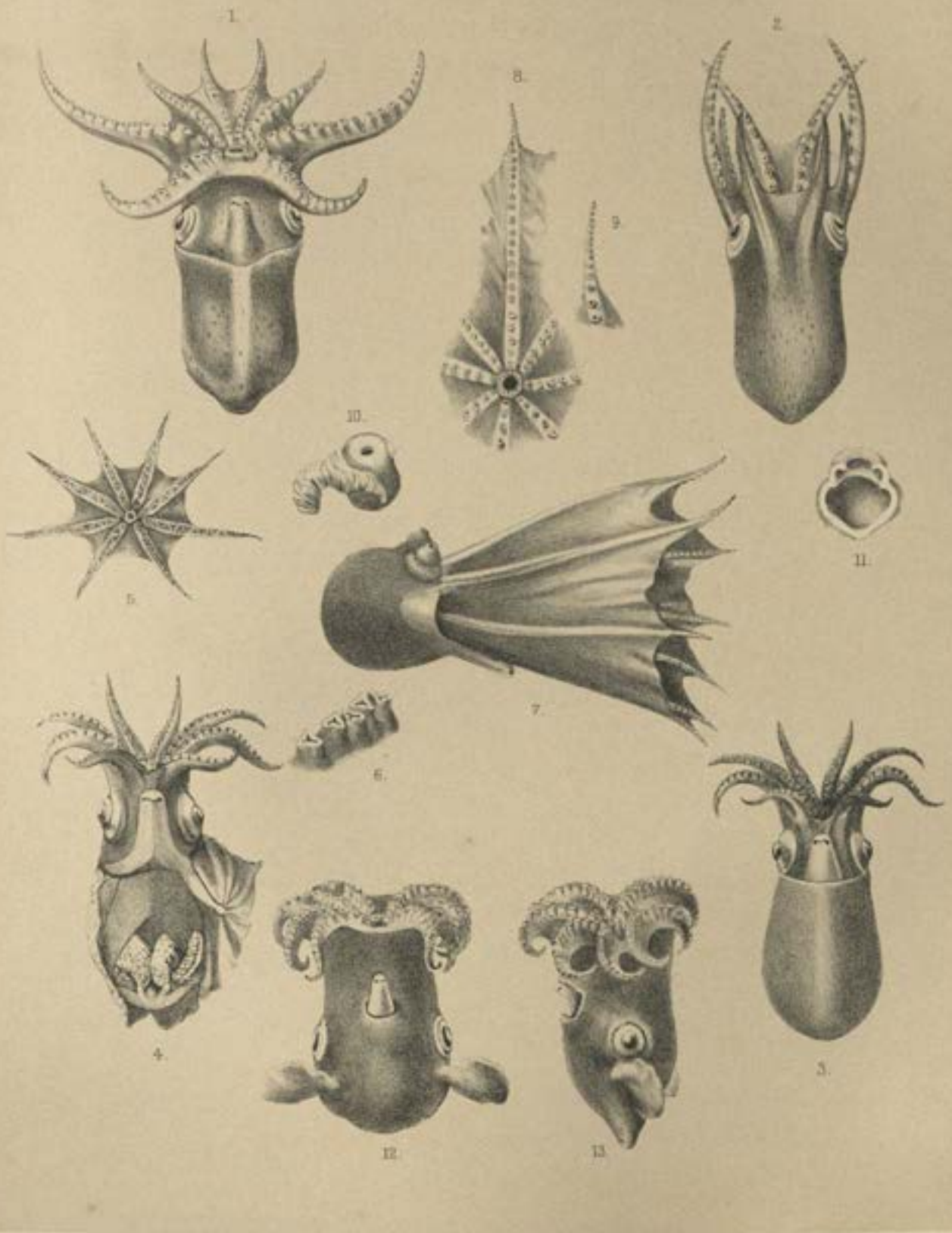
Fig. 10. Sucker taken from large dead *Cirroteuthis*, with portion of cutaneous membrane attached; slightly reduced.

Fig. 11. Section of a similar sucker; slightly enlarged.

Figs. 12, 13. CIRROTEUTHIS MEANGENSIS, Hoyle, . . 63

Fig. 12. Ventral view of the specimen; the postero-lateral angles should be a little more pronounced; magnified 4 diameters.

Fig. 13. Side view of the same specimen; magnified 4 diameters.



1, 2. JAPETELLA PRISMATICA, n. gen., n. sp. 3–6. ELEDONELLA DIAPHANA, n. sp.
7–9. AMPHITRETUS PELAGICUS, n. gen., n. sp. 10, 11. CIRROTEUTHIS, sp.?
12, 13. CIRROTEUTHIS, sp., juv.

PLATE X.

PLATE X.

PAGE

CIRROTEUTHIS PACIFICA, n. sp., . . . 61

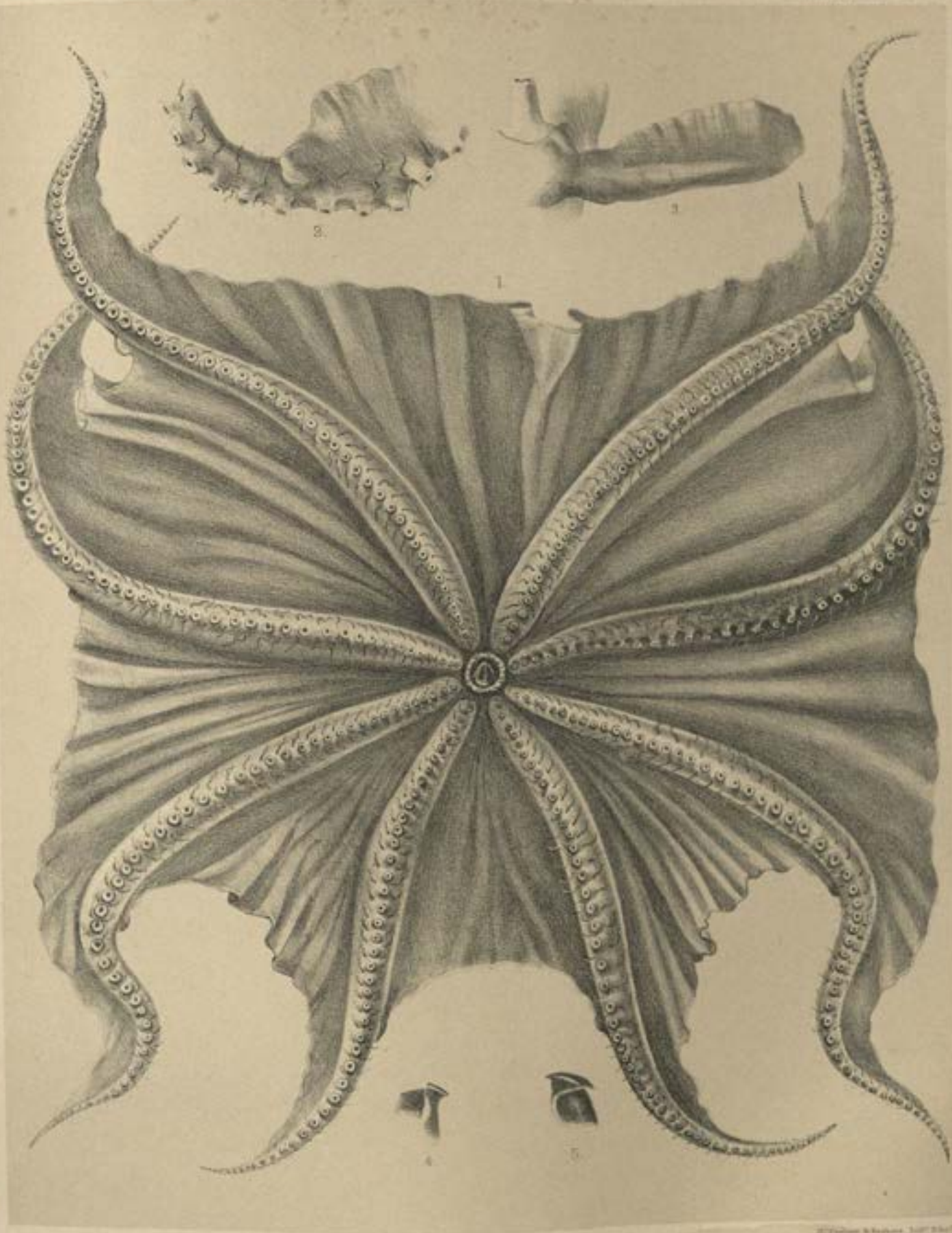
Fig. 1. View of the anterior surface of the umbrella with the arms and mouth; natural size.

Fig. 2. Portion of the ventral aspect of an arm, showing the attachment of the membrane and the nodule; natural size.

Fig. 3. Portion of the ventral aspect of the body, showing the siphon and fin; natural size.

Fig. 4. The ventral mandible; natural size.

Fig. 5. The dorsal mandible; natural size.



CIRROTEUTHIS PACIFICA, n. sp.

PLATE XI.

PLATE XI.

PAGE

Figs. 1, 2. CIRROTEUTHIS MEANGENSIS, n. sp., . . . 63

Fig. 1. Front view of right dorsal arm, showing the attachment of the web to it, and the nodule on its ventral aspect; natural size.

Fig. 2. View of the ventral side of the distal half of the same arm, showing the cirri continued to the extremity of the arm, and the nodule, with the margin of the web passing over it; magnified about 2 diameters.

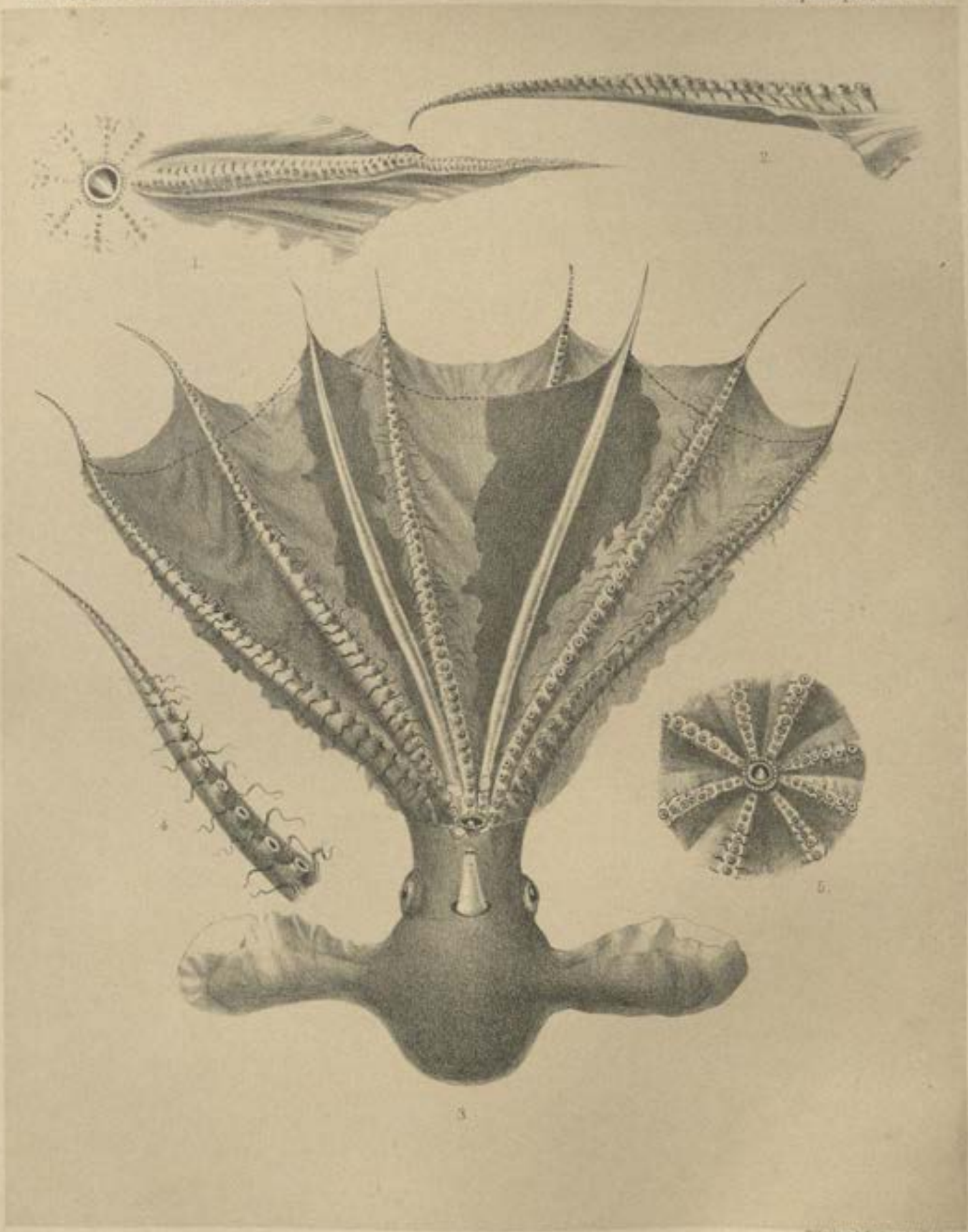
Figs. 3–5. CIRROTEUTHIS MAGNA,[1] n. sp., . . 60

Fig. 3. Ventral view of the animal; the greater part of the ventral side of the umbrella has been removed, and also the proximal portions of the two ventral arms. The distal margin of the membrane has been erroneously restored under the impression that the specimen was to be referred to the genus *Stauroteuthis* (see p. 61); natural size.

Fig. 4. Distal portion of an arm, showing the suckers and cirri; enlarged about 3 diameters.

Fig. 5. Central portion of umbrella and mouth, showing the proximal suckers and cirri; natural size.

[1] The name has been changed since the plate was printed off.



1, 2. CIRROTEUTHIS MEANGENSIS, n. sp. 3–5. STAUROTEUTHIS ?

PLATE XII.

PLATE XII.

PAGE

CIRROTEUTHIS MAGNA, n. sp., . . . 56

Fig. 1. The animal viewed from the left side; the lateral arms of that side and the portions of the web attached to them have been removed so as to show the arrangement of the umbrella and the intermediate webs; one-sixth natural size.

Fig. 2. The tip of an arm, seen from the dorsal aspect; natural size.

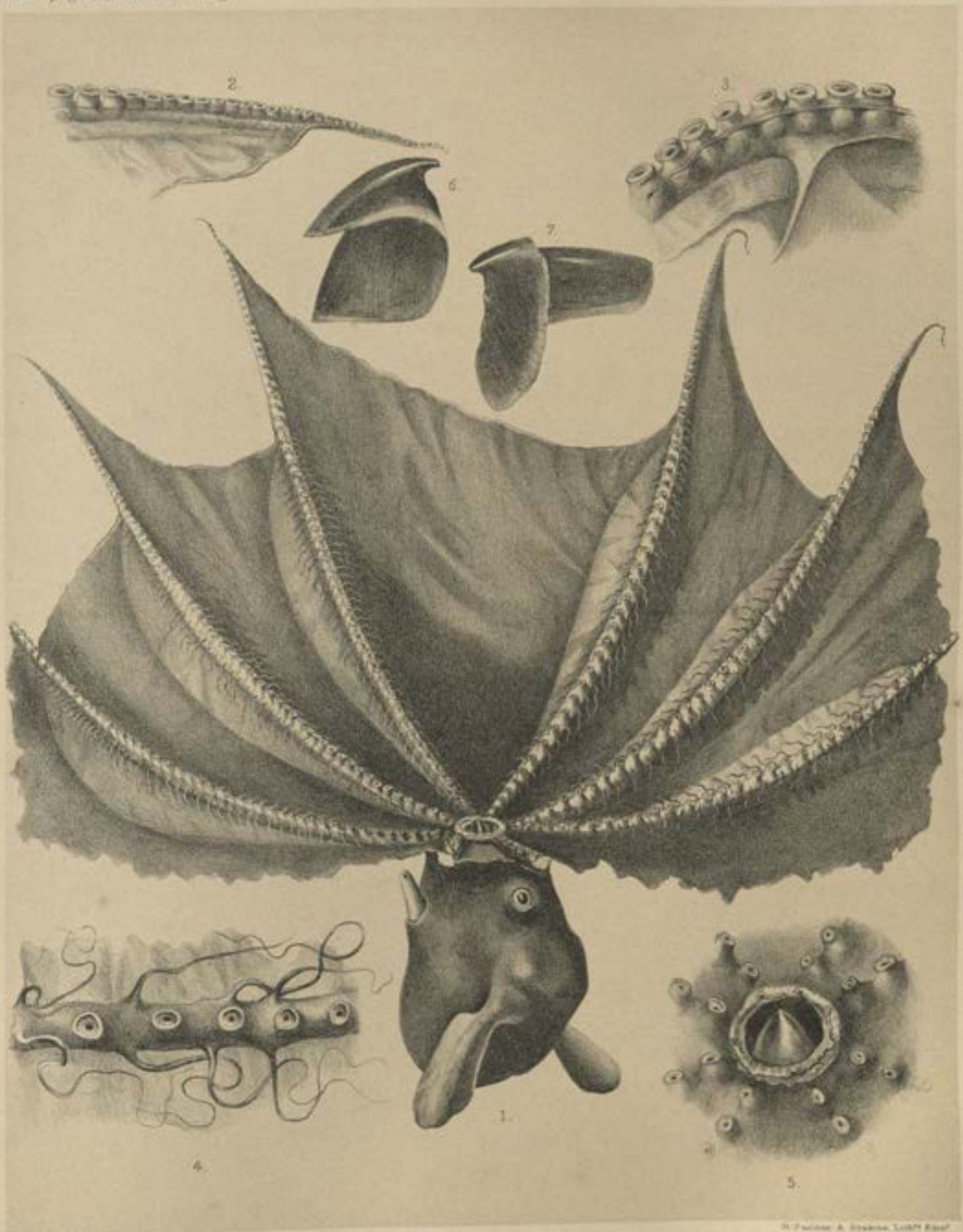
Fig. 3. Portion of the ventral aspect of the right dorsal arm (the base being towards the right), showing the expansion of the margin of the web where it is fixed to the arm, and its attachment to the membrane which passes backwards from the arm, forming the intermediate web; natural size.

Fig. 4. Portion of the middle of an arm, showing some of the longest cirri; natural size.

Fig. 5. The mouth with the proximal suckers and ventral mandible; natural size.

Fig. 6. The dorsal mandible; natural size.

Fig. 7. The ventral mandible; natural size.



CIRROTEUTHIS MAGNA, n. sp.

PLATE XIII.

PLATE XIII.

PAGE

Figs 1–4. CIRROTEUTHIS MAGNA, n. sp., . 56

Fig. 1. The dorsal cartilage, seen from the posterior aspect; natural size.

Fig. 2. The same cartilage, seen from above, showing the thin margins bending inwards over the dorsal surface so as to enclose a narrow space; natural size.

Fig. 3. Dorsal view of the cartilage of the specimen figured in Pl. XI. fig. 3; natural size.

Fig. 4. Posterior aspect of the same cartilage; natural size.

Figs. 5, 6. CIRROTEUTHIS MEANGENSIS, n. sp., . 63

Fig. 5. Posterior aspect of the cartilage of the specimen shown in Pl. XI. figs. 1, 2; natural size.

Fig. 6. Dorsal view of the same cartilage; natural size.

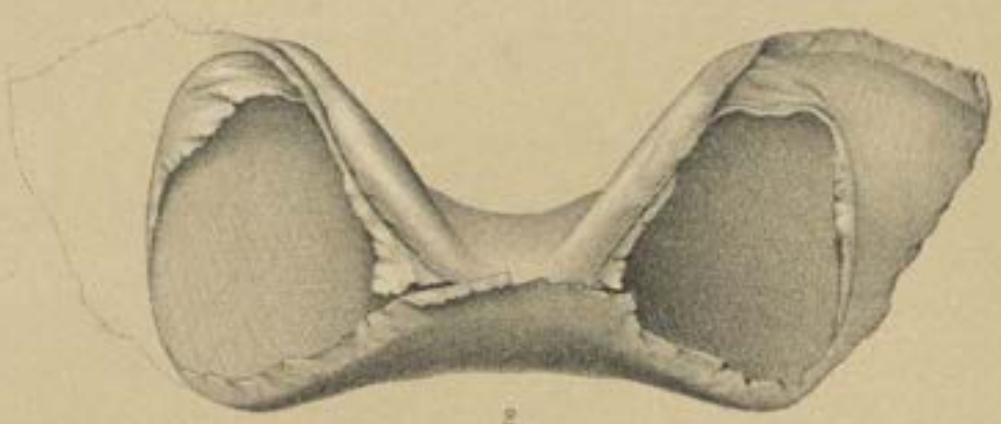
Fig. 7. TREMOCTOPUS QUOYANUS, d'Orb., . 70

Fig 7. View of the head and arms, showing about five suckers of the hectocotylised arm protruding from its sac; magnified 3 diameters.

Figs. 8, 9. TREMOCTOPSIS GRACILIS (?), Eydoux et Souleyet, 71

Fig. 8. The animal seen from the right ventro-lateral aspect, showing the hectocotylised arm coiled up beneath the integuments; magnified about 3 diameters.

Fig. 9. The hectocotylised arm removed from the sac; magnified 20 diameters. *a*, the swelling which afterwards forms the cyst near the extremity.



1–4. CIRROTEUTHIS MAGNA, n. sp.
7. TREMOCTOPUS QUOYANUS, (d'Orb.)
5, 6. CIRROTEUTHIS MEANGENSIS, n. sp.
8, 9. TREMOCTOPUS GRACILIS (?) (Fig. 8 & 9)

PLATE XIV.

PLATE XIV.

PAGE

Figs. 1–9. INIOTEUTHIS MORSEI, Verrill,[1] 112

Fig. 1. Dorsal view of a specimen; natural size.

Fig. 2. Lateral view of a sucker from one of the sessile arms; magnified 20 diameters.

Fig. 3. Front view of the same sucker; magnified 20 diameters.

Fig. 4. View of the right tentacular club; magnified 2 diameters.

Fig. 5. The right tentacular club of another specimen, seen from the outer aspect, to show the row of chromatophores upon it; magnified 2 diameters.

Fig. 6. An urceolate tentacular sucker, magnified 250 diameters.

Fig. 7. The distal extremity of a similar sucker; magnified 250 diameters.

Fig. 8. A similar sucker in optical section; magnified 250 diameters.

Fig. 9. Inner surface of the right ventral arm, to show the arrangement of the proximal suckers in two series; natural size.

Figs. 10–14. PROMACHOTEUTHIS MEGAPTERA, n. gen., n. sp., 120

Fig. 10. Side view of the head, arms, and siphon, with the almond-shaped pit for articulation with the mantle; magnified 3 diameters.

Fig. 11. Ventral aspect of the head and siphon; magnified 3 diameters.

Fig. 12. Portion of an arm, showing the arrangement of the suckers; magnified 7 diameters.

Fig. 13. Circumoral region, showing the thick papillate lip and the bases of the arms and tentacles; magnified 2 diameters.

Fig. 14. A sucker from one of the arms; magnified 30 diameters.

[1] The name has been changed since the plate was printed off.

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1–9. SEPIOLA BURSA (?), Pfft.

10–14. PROMACHOTEUTHIS MEGAPTERA, n. gen. n. sp.

PLATE XV.

PLATE XV.

PAGE

Figs. 1–9. ROSSIA OWENI, Ball, ... 114

Fig. 1. Dorsal view of a female specimen; natural size.

Fig. 2. The left dorsal arm of a male, showing the form of hectocotylisation; magnified 2 diameters.

Fig. 3. A large sucker from one of the lateral arms of the male, seen from the side; magnified 7 diameters.

Fig. 4. Front view of the same sucker; magnified 7 diameters.

Fig. 5. Second right arm of the male; natural size.

Fig. 6. Left tentacular club of the female specimen shown in fig. 1; very slightly enlarged.

Fig. 7. A large tentacular sucker; magnified 20 diameters.

Fig. 8. Profile view of the two rings of conical papillæ which surround the horny ring of a tentacular sucker; magnified 200 diameters.

Fig. 9. A portion of the horny ring of a similar sucker, with the papillary area surrounding it; magnified 200 diameters.

Figs 10–18. ROSSIA PATAGONICA, E. A. Smith, . . 119

Fig. 10. Third left arm of a male specimen; magnified 2 diameters.

Fig. 11. Second left arm of the same specimen; magnified 2 diameters.

Fig. 12. Inner aspect of the third left arm of another specimen; magnified 2 diameters.

Fig. 13. The outer aspect of the left dorsal arm of the male, showing the form of hectocotylisation; magnified 2 diameters.

Fig. 14. Lateral view of an enlarged sucker from one of the lateral arms of the male; magnified 8 diameters.

Fig. 15. The left tentacular club; magnified about 5 diameters.

Fig. 16. A sucker from the tentacular club; magnified 40 diameters.

Fig. 17. Part of the horny ring of a tentacular sucker, with two teeth and the adjacent papillary area; magnified 200 diameters.

Fig. 18. Part of the horny ring of a sucker from one of the sessile arms; with the adjacent papillary area; magnified 200 diameters.

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1–9. ROSSIA OWENI, Ball. 10–18. ROSSIA PATAGONICA, E. A. Smith.

PLATE XVI.

PLATE XVI.

PAGE

Figs. 1–12. SEPIA SMITHI, n. sp., . . . 124

Fig. 1. Dorsal view of one of the larger specimens; natural size.

Fig. 2. Ventral view of the head and siphon; natural size.

Fig. 3. View of the median aspect of the left tentacular club; natural size.

Fig. 4. View of the lateral aspect of the other club, to show the swimming-web and both protective membranes; natural size.

Fig. 5. Ventro-lateral view of the left tentacular club, showing one of the protective membranes (on the left of the figure) and the swimming-web on the right; natural size. This and the two preceding figures were taken from a somewhat larger specimen, whose mantle measured 85 mm. in length.

Fig. 6. A sucker from one of the sessile arms; magnified about 20 diameters.

Fig. 7. A similar sucker; magnified 20 diameters.

Fig. 8. One of the tentacular suckers; highly magnified.

Fig. 9. One tooth of the horny ring and the adjacent papillary area; magnified 200 diameters.

Fig. 10. Ventral aspect of the shell; natural size.

Fig. 11. Lateral aspect of the shell; natural size.

Fig. 12. Dorsal aspect of the shell; natural size.

Figs. 13–23. SEPIA PAPUENSIS, n. sp., . . . 126

Fig. 13. Dorsal view of the larger specimen; natural size.

Fig. 14. View of the ventral surface of the head and siphon; natural size.

Fig. 15. Tentacular club; magnified 6 diameters.

Fig. 16. Dorsal mandible; natural size.

Fig. 17. Ventral mandible; natural size.

Fig. 18. A tentacular sucker; magnified 20 diameters.

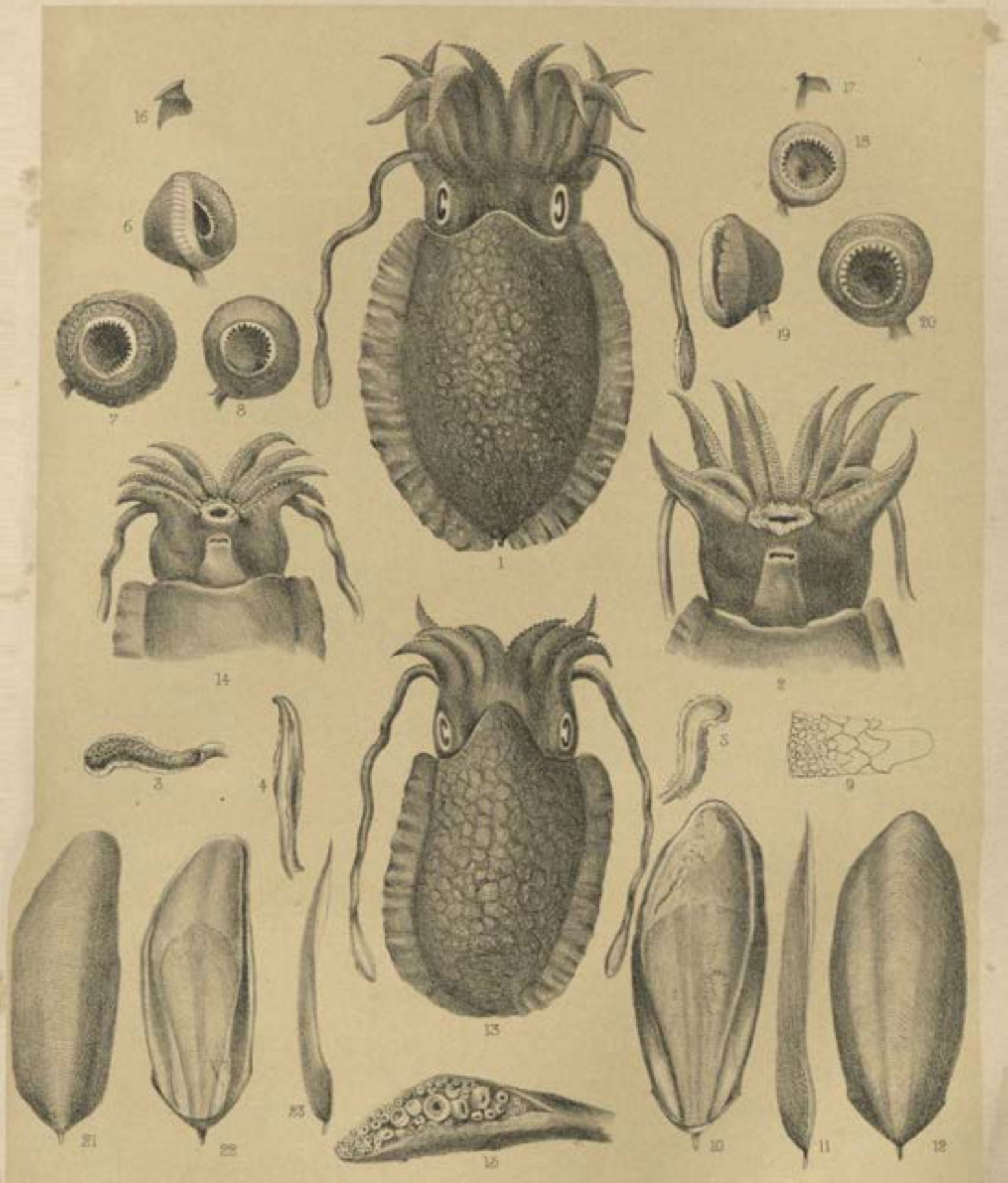
Fig. 19. A sucker of a sessile arm, seen from the side; magnified 20 diameters.

Fig. 20. Another sucker from a sessile arm, seen from the front; magnified 20 diameters.

Fig. 21. Dorsal view of the shell; natural size.

Fig. 22. Ventral view of the shell; natural size.

Fig. 23. Lateral view of the shell; natural size.



1–12, SEPIA SMITHI, n. sp. 13–23, SEPIA PAPUENSIS, n. sp.

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Figs. 1–5. SEPIA ESCULENTA, n. sp., . . . 129

Fig. 1. Dorsal view of the female specimen; natural size.

Fig. 2. The left ventral arm of the same specimen; magnified 1·5 diameter.

Fig. 3. Lateral aspect of the shell of the female specimen; natural size.

Fig. 4. The ventral mandible; natural size.

Fig. 5. The dorsal mandible; natural size.

Figs. 6–11. SEPIA KIENSIS, n. sp., . . . 141

Fig. 6. Ventral aspect of the specimen; natural size.

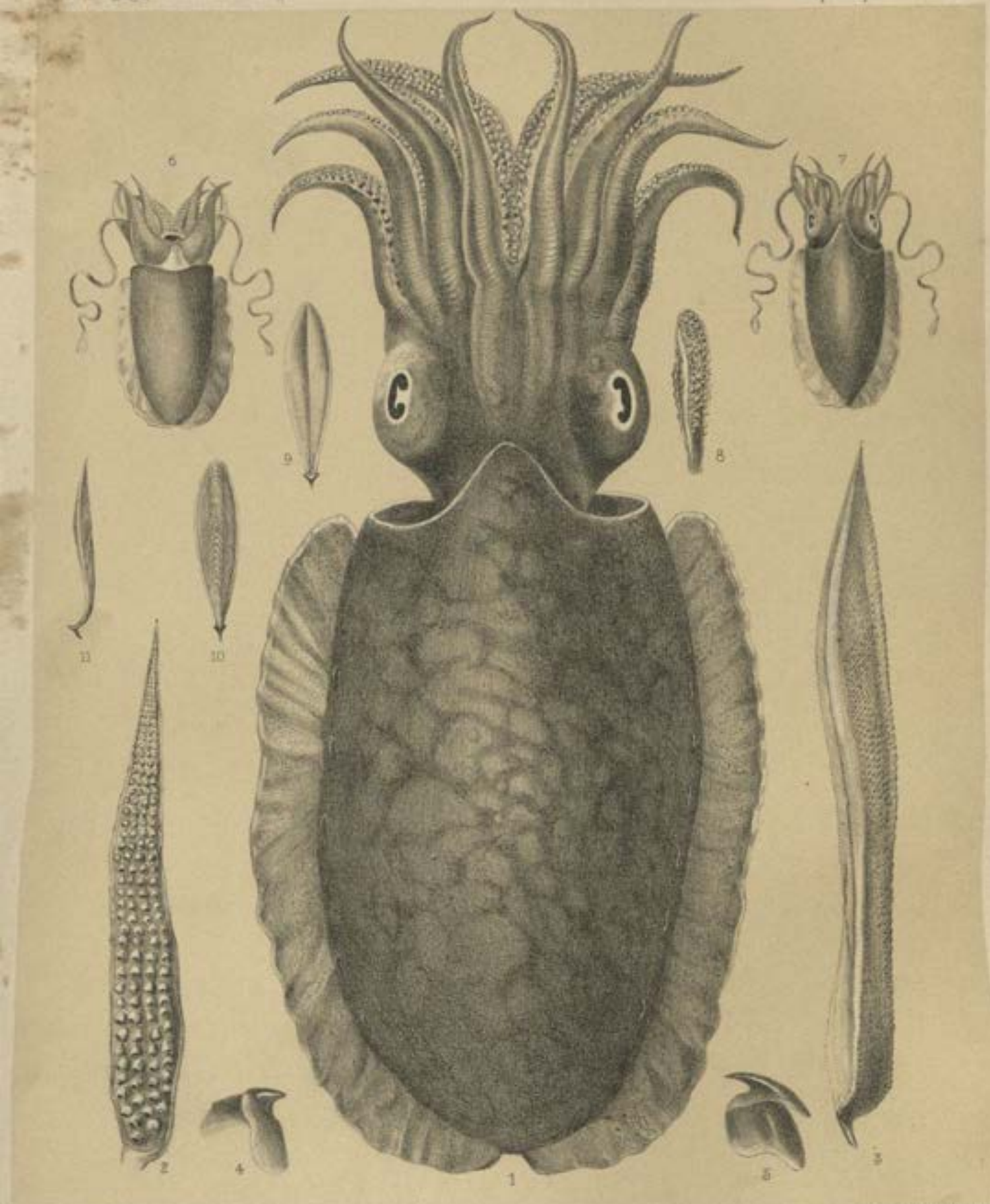
Fig. 7. Dorsal aspect of the specimen; natural size. The head was somewhat more retracted into the mantle than is indicated in the drawing.

Fig. 8. The left tentacular club; magnified 5 diameters.

Fig. 9. Ventral aspect of the shell; natural size.

Fig. 10. Dorsal aspect of the shell; natural size.

Fig. 11. Lateral aspect of the shell; natural size.



1–5. SEPIA ESCULENTA, n. sp. 6–11. SEPIA KIENSIS, n. sp.

PLATE XVIII.

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Figs. 1–6. SEPIA ESCULENTA, n. sp., . . . 129

Fig. 1. Ventral aspect of the shell of the female; natural size.

Fig. 2. Dorsal aspect of the shell of the female; natural size.

Fig. 3. Ventral aspect of the shell of the male; natural size.

Fig. 4. Part of the margin of a sucker from one of the sessile arms. The upper part of the drawing shows the smooth horny ring, while below it is the papillary area; highly magnified.

Fig. 5. Sucker from one of the sessile arms; magnified about 8 diameters.

Fig. 6. The parts surrounding the mouth of the male, showing the bases of the arms, the hectocotylisation of the left ventral one, the buccal membrane, and the inner and outer lips; natural size.

Figs. 7–14. SEPIA KOBIENSIS, n. sp., . . . 142

Fig. 7. Dorsal view of the specimen; natural size.

Fig. 8. Ventral view of the specimen; natural size. Showing the fins terminating on the ventral surface some distance from the extremity of the animal.

Fig. 9. Club of the left tentacle; magnified 7 diameters.

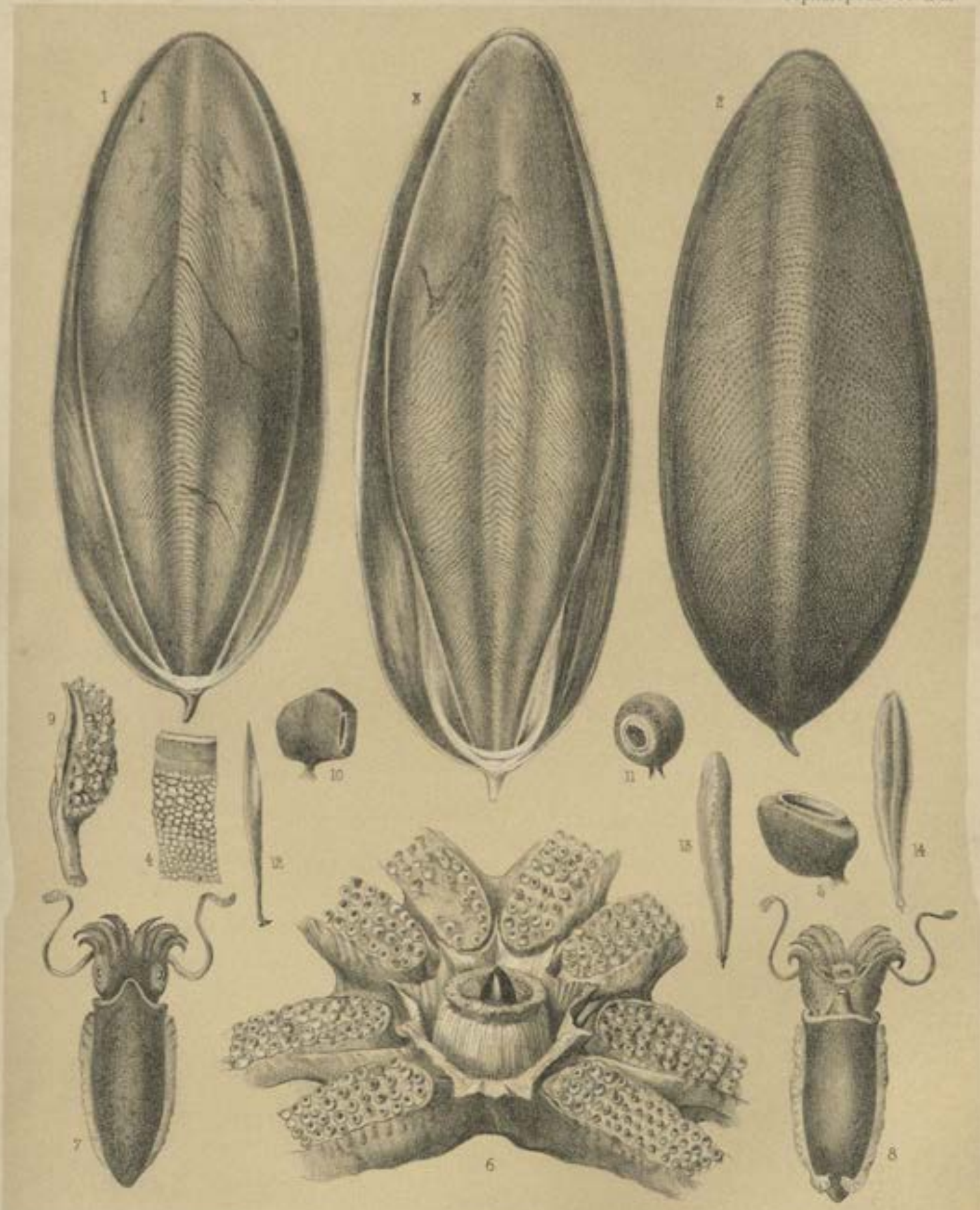
Fig. 10. A sucker from one of the sessile arms; magnified 20 diameters.

Fig. 11. Another view of a similar sucker, in which the distal depression is not marked; magnified 20 diameters.

Fig. 12. Lateral view of the shell; natural size.

Fig. 13. Dorsal view of the shell; natural size.

Fig. 14. Ventral view of the shell; natural size.



1–6. SEPIA ESCULENTA, n. sp.

7–14. SEPIA KOBIENSIS, n. sp.

PLATE XIX.

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Figs. 1–13. SEPIA SULCATA, n. sp., . . . 137

Fig. 1. Ventral aspect of the specimen; natural size.

Fig. 2. Dorsal aspect of the specimen; natural size.

Fig. 3. The left tentacular club; magnified 7 diameters.

Fig. 4. The hectocotylised arm; magnified 2 diameters.

Fig. 5. A transverse section of the same, to show the groove and the rounded fillet lying in it; magnified 3 diameters.

Fig. 6. A tentacular sucker; magnified 40 diameters.

Fig. 7. A sucker from one of the sessile arms; magnified 40 diameters.

Fig. 8. A portion of the papillary area; magnified 200 diameters.

Fig. 9. The ventral mandible; natural size.

Fig. 10. The dorsal mandible; natural size.

Fig. 11. Ventral aspect of the shell; natural size.

Fig. 12. Lateral aspect of the shell; natural size.

Fig. 13. Dorsal aspect of the shell; natural size.

Figs. 14–24. SEPIA ELLIPTICA, n. sp., . . . 131

Fig. 14. Dorsal view of a specimen; natural size.

Fig. 15. Ventral view of a specimen; natural size.

Fig. 16. Inner aspect of the hectocotylised arm; magnified 2 diameters.

Fig. 17. A sucker from a sessile arm, with smooth horny ring; magnified 20 diameters.

Fig. 18. A portion of the papillary area, the upper margin is the horny ring; magnified 200 diameters.

Fig. 19. A somewhat compressed sucker from a sessile arm, showing slight toothing of the distal margin of the horny ring; magnified 20 diameters.

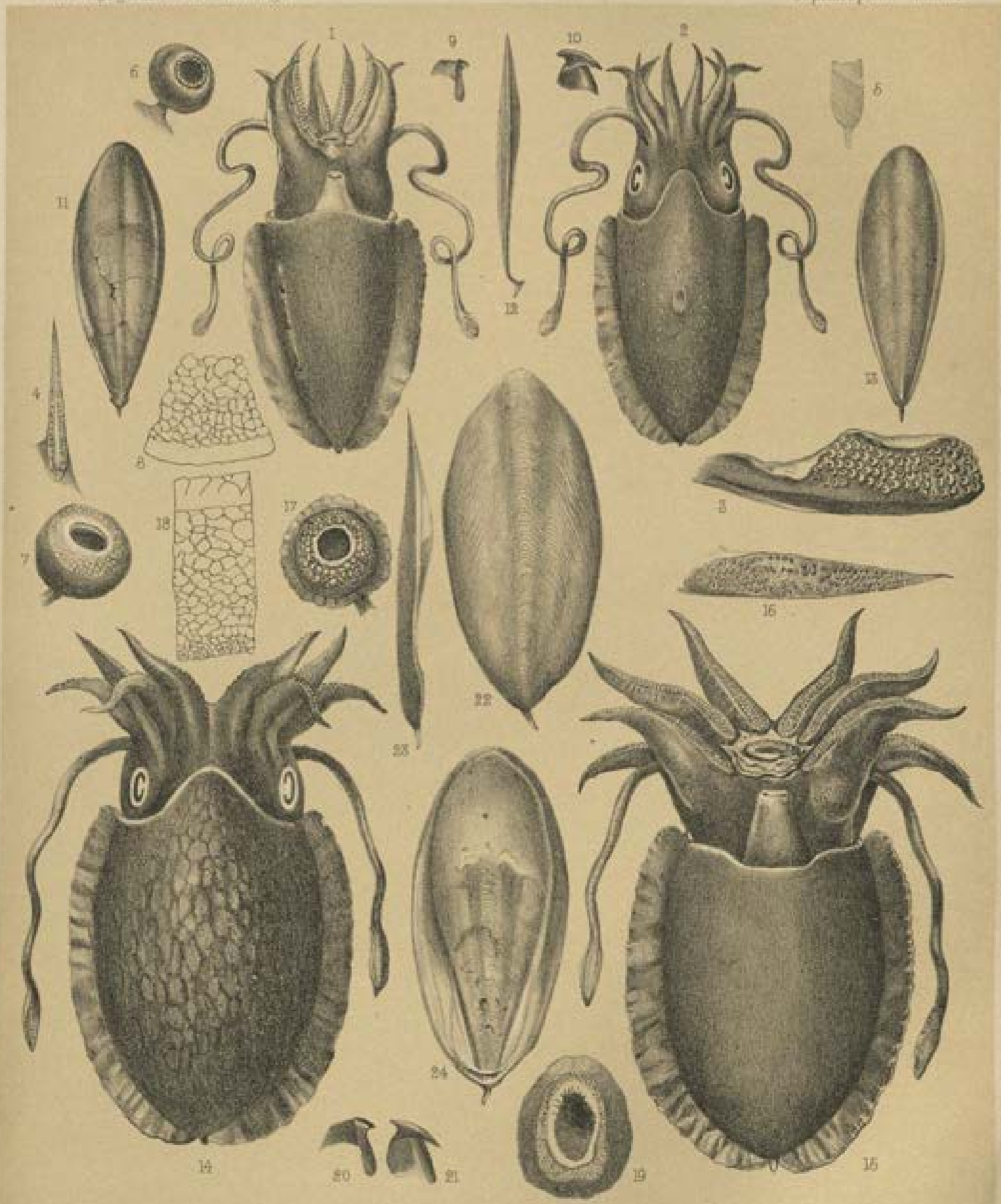
Fig. 20. Ventral mandible; natural size.

Fig. 21. Dorsal mandible; natural size.

Fig. 22. Dorsal aspect of the shell; natural size.

Fig. 23. Lateral aspect of the shell; natural size.

Fig. 24. Ventral aspect of the shell; natural size.



1-13. SEPIA SULCATA, n. sp. 14-24. SEPIA ELLIPTICA, n. sp.

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SEPIA CULTRATA, Steenstrup, 133

Fig. 1. Dorsal aspect of the specimen; natural size.

Fig. 2. Ventral aspect of the specimen; natural size.

Fig. 3. The circumoral region, showing the bases of the arms, the inner and outer lips, and the spermatic pad with a few spermatophores adhering to it; magnified 2 diameters.

Fig. 4. Inner aspect of one of the sessile arms; magnified 2 diameters.

Fig. 5. Right tentacular club; magnified 7 diameters.

Fig. 6. Sucker from one of the sessile arms; magnified about 15 diameters.

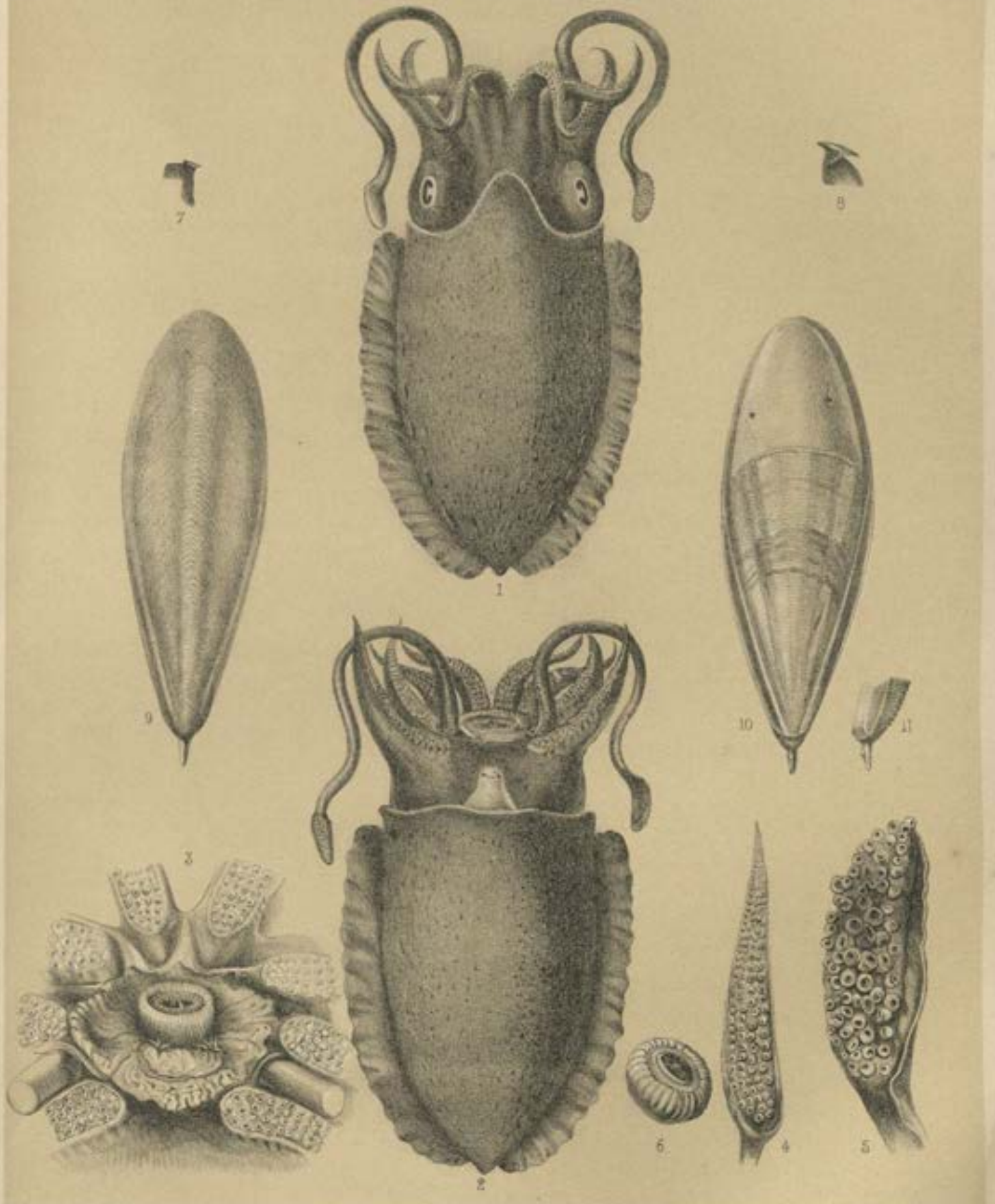
Fig. 7. The ventral mandible; natural size.

Fig. 8. The dorsal mandible; natural size.

Fig. 9. Dorsal aspect of the shell; natural size.

Fig. 10. Ventral aspect of the shell; natural size.

Fig. 11. Side view of the extremity of the shell, showing the knife-like ridge on the spine; natural size.



SEPIA CULTRATA. Stp.

PLATE XXI.

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Figs. 1–10. SEPIA (METASEPIA) PFEFFERI, n. sp., 145

Fig. 1. Dorsal view of the specimen; natural size.

Fig. 2. Ventral view of the anterior portion; natural size.

Fig. 3. Circumoral region, showing the lips, buccal membrane, spermatic pad with some spermatophores upon it, and the bases of the arms; magnified 2 diameters.

Fig. 4. Dorsal aspect of the shell; natural size.

Fig. 5. Ventral aspect of the shell; natural size.

Fig. 6. Inner aspect of one of the arms; natural size.

Fig. 7. The left tentacular club; magnified about 3 diameters.

Fig. 8. The ventral mandible; natural size.

Fig. 9. The dorsal mandible; natural size.

Fig. 10. A sucker from one of the sessile arms; magnified 15 diameters.

Figs. 11–19. SEPIA ANDREANOIDES, n. sp., 139

Fig. 11. Ventral view of a specimen, with the tentacles retracted; natural size.

Fig. 12. Dorsal view, with extended tentacles; natural size.

Fig. 13. The right tentacular club; magnified about 3 diameters.

Fig. 14. Dorsal aspect of the shell; natural size.

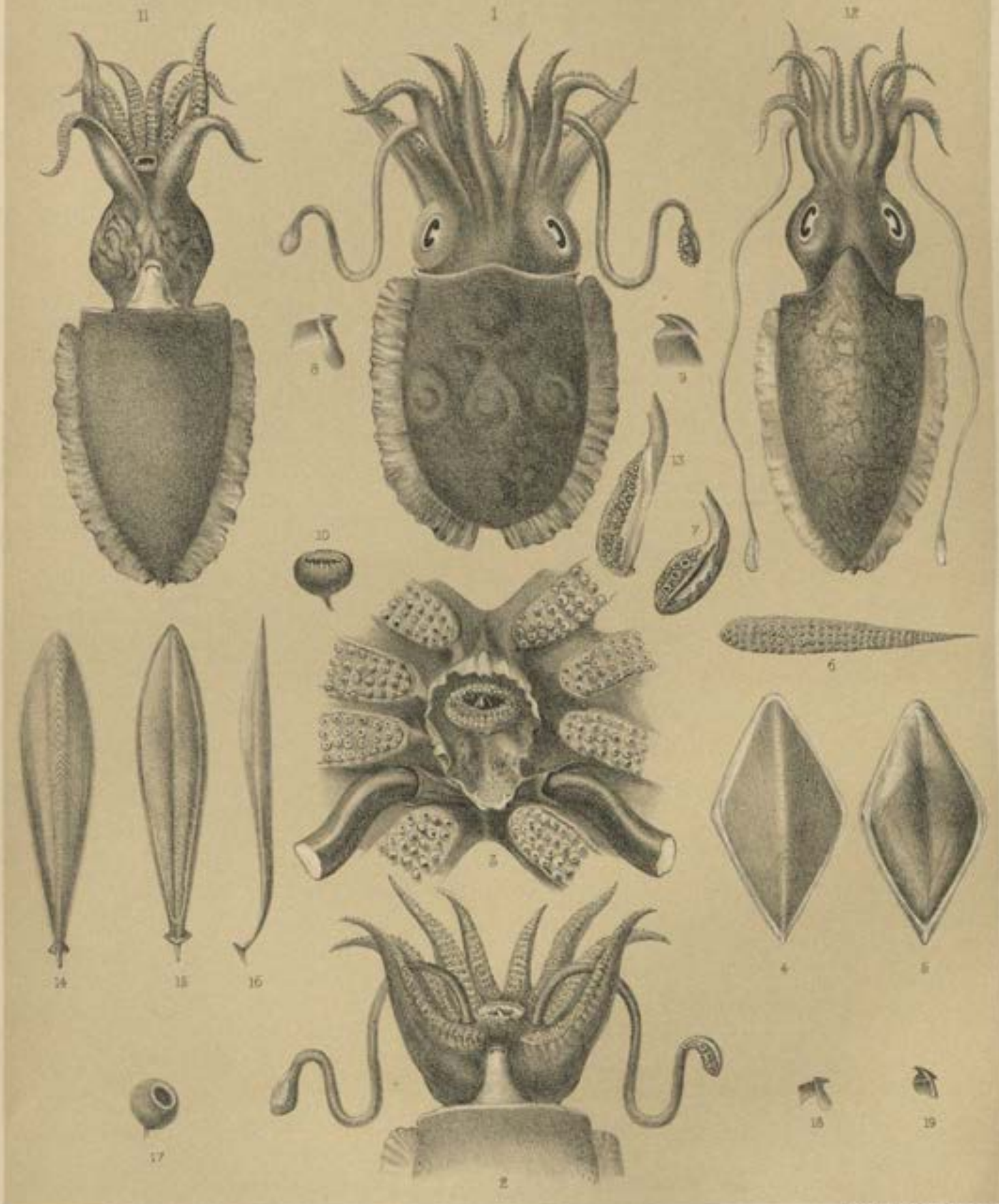
Fig. 15. Ventral aspect of the shell; natural size.

Fig. 16. Lateral aspect of the shell; natural size.

Fig. 17. A sucker from one of the sessile arms; magnified 12 diameters.

Fig. 18. Ventral mandible; natural size.

Fig. 19. Dorsal mandible; natural size.



1–10. SEPIA (METASEPIA) PFEFFERI, n. sp. 11–19. SEPIA ANDREANOIDES, n. sp.

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Figs. 1–10. SEPIELLA MAINDRONI, de Rochebrune, 149

Fig. 1. Ventral aspect of the specimen; natural size.

Fig. 2. Side view of a sucker from one of the sessile arms; magnified 20 diameters.

Fig. 3. Front view of the same sucker; magnified 20 diameters.

Fig. 4. A tentacular sucker on its peduncle; magnified 20 diameters.

Fig. 5. Front view of a similar sucker; magnified 20 diameters.

Fig. 6. The distal half of the horny ring of a similar sucker, to show the denticulation; magnified 30 diameters.

Fig. 7. A portion of the papillary area from a similar sucker; magnified 200 diameters.

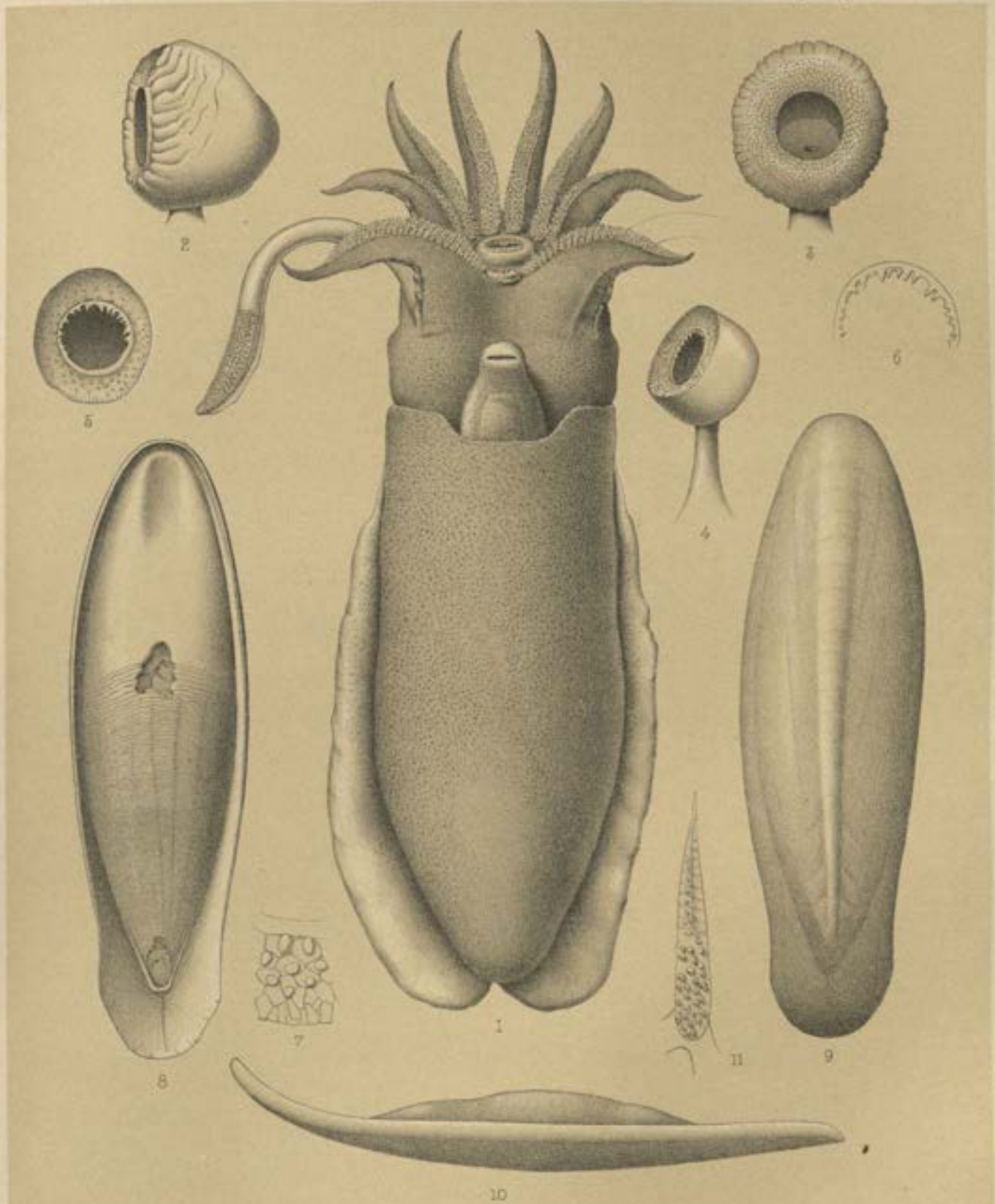
Fig. 8. Ventral aspect of the shell; natural size.

Fig. 9. Dorsal aspect of the shell; natural size.

Fig. 10. Lateral aspect of the shell; natural size.

Fig. 11. SEPIA ANDREANOIDES, n. sp., 139

Fig. 11. The hectocotylised arm of the male specimen; magnified 2 diameters.



1–10. SEPIELLA MAINDRONI (?) Rochebr. 11. SEPIA ANDREANOIDES, n. sp.

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LOLIGO EDULIS, n. sp., ... 152

Fig. 1. Ventral aspect of the specimen; natural size.

Fig. 2. Dorsal aspect of the head; natural size.

Fig. 3. Lateral view of a sucker, from one of the sessile arms; magnified 11 diameters.

Fig. 4. Front view of a similar sucker; magnified 11 diameters.

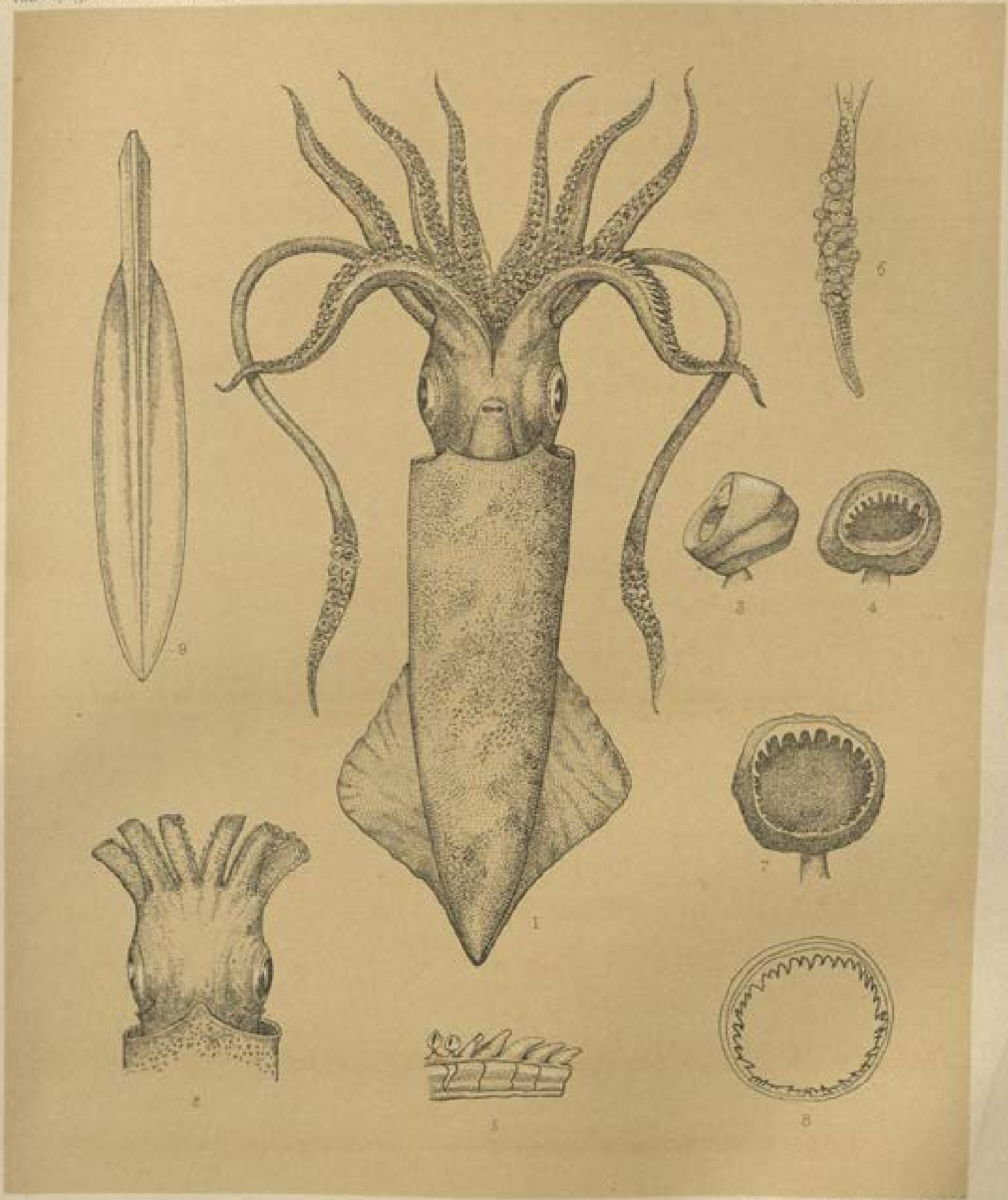
Fig. 5. Portion of the hectocotylised arm, showing the transition from the suckers to the conical papillæ, seen from the ventral side; magnified 3 diameters.

Fig. 6. The tentacular club; magnified 2 diameters.

Fig. 7. Lateral sucker, from the tentacular club; magnified 20 diameters.

Fig. 8. Horny ring, from one of the large tentacular suckers; magnified 20 diameters.

Fig. 9. Dorsal aspect of the gladius; natural size.



LOLIGO EDULIS, n. sp.

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Figs. 1–6. LOLIGO ELLIPSURA, n. sp., 160

Fig. 1. The specimen, seen from the ventral aspect; natural size.

Fig. 2. The dorsal surface of the head; natural size.

Fig. 3. Part of the horny ring and papillary area, from a large tentacular sucker; magnified 450 diameters.

Fig. 4. Side view of a sucker, from one of the sessile arms; magnified 60 diameters.

Fig. 5. Front view of a similar sucker; magnified 60 diameters.

Fig. 6. A lateral tentacular sucker; magnified 100 diameters.

Figs. 7–15. LOLIGO JAPONICA, Steenstrup, . . . 157

Fig. 7. The specimen, seen from the ventral aspect; natural size.

Fig. 8. Side view of a sucker, from one of the sessile arms; magnified 10 diameters.

Fig. 9. A terminal tentacular sucker; magnified 50 diameters.

Fig. 10. The hectocotylised arm of a specimen in the Copenhagen Museum; magnified 2 diameters. Drawn by Mr. Thornam.

a. A small portion, still more enlarged, to show the form of the papillæ.

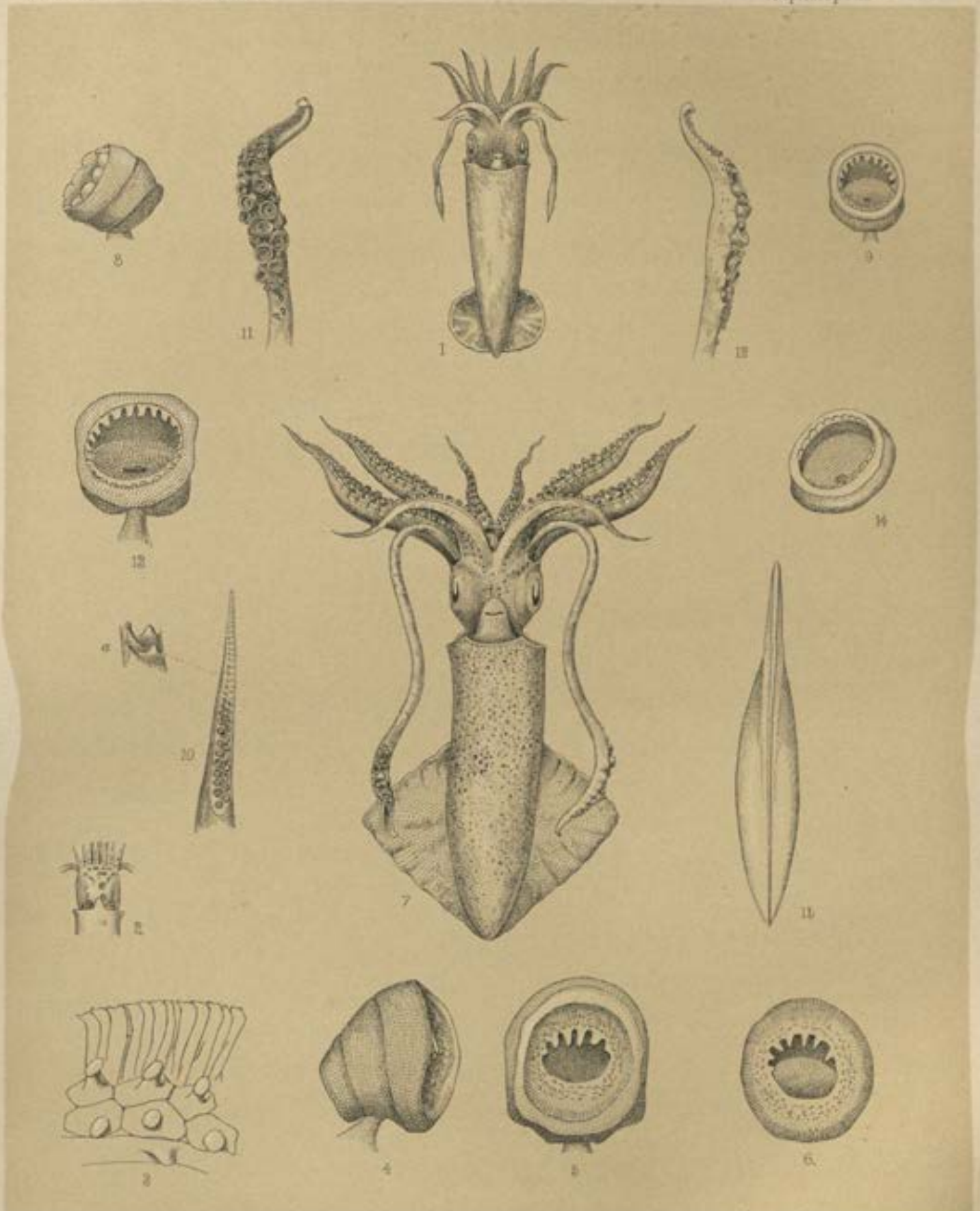
Fig. 11. Inner aspect of the tentacular club; magnified 2 diameters.

Fig. 12. Lateral aspect of the tentacular club; magnified 2 diameters.

Fig. 13. A lateral tentacular sucker; magnified 20 diameters.

Fig. 14. A median tentacular sucker; magnified 10 diameters.

Fig. 15. The gladius; natural size.



1–6. LOLIGO ELLIPSURA, n. sp. 7–13. LOLIGO JAPONICA, Stp.

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Figs. 1–10. LOLIGO KOBIENSIS, n. sp., . . . 154

Fig. 1. Ventral view of the animal; natural size.

Fig. 2. Side view of a sucker from one of the sessile arms; magnified 10 diameters.

Fig. 3. Front view of a similar sucker; magnified 10 diameters.

Fig. 4. The circumoral region, showing the ventral mandible, the lips, and the buccal membrane, with suckers upon its points and the spermatic pad in the ventral median line; there are no spermatophores on the pad, but a few may be seen on the left ventral arm (*a*).

Fig. 5. The tentacular club; slightly enlarged.

Fig. 6. Side view of a median tentacular sucker; magnified 7 diameters.

Fig. 7. Front view of a similar sucker; magnified 7 diameters.

Fig. 8. A terminal tentacular sucker; magnified 20 diameters.

Fig. 9. A lateral tentacular sucker; magnified 10 diameters.

Fig. 10. The gladius; natural size.

Figs. 11–15. LOLIGO ELLIPSURA, n. sp., . 160

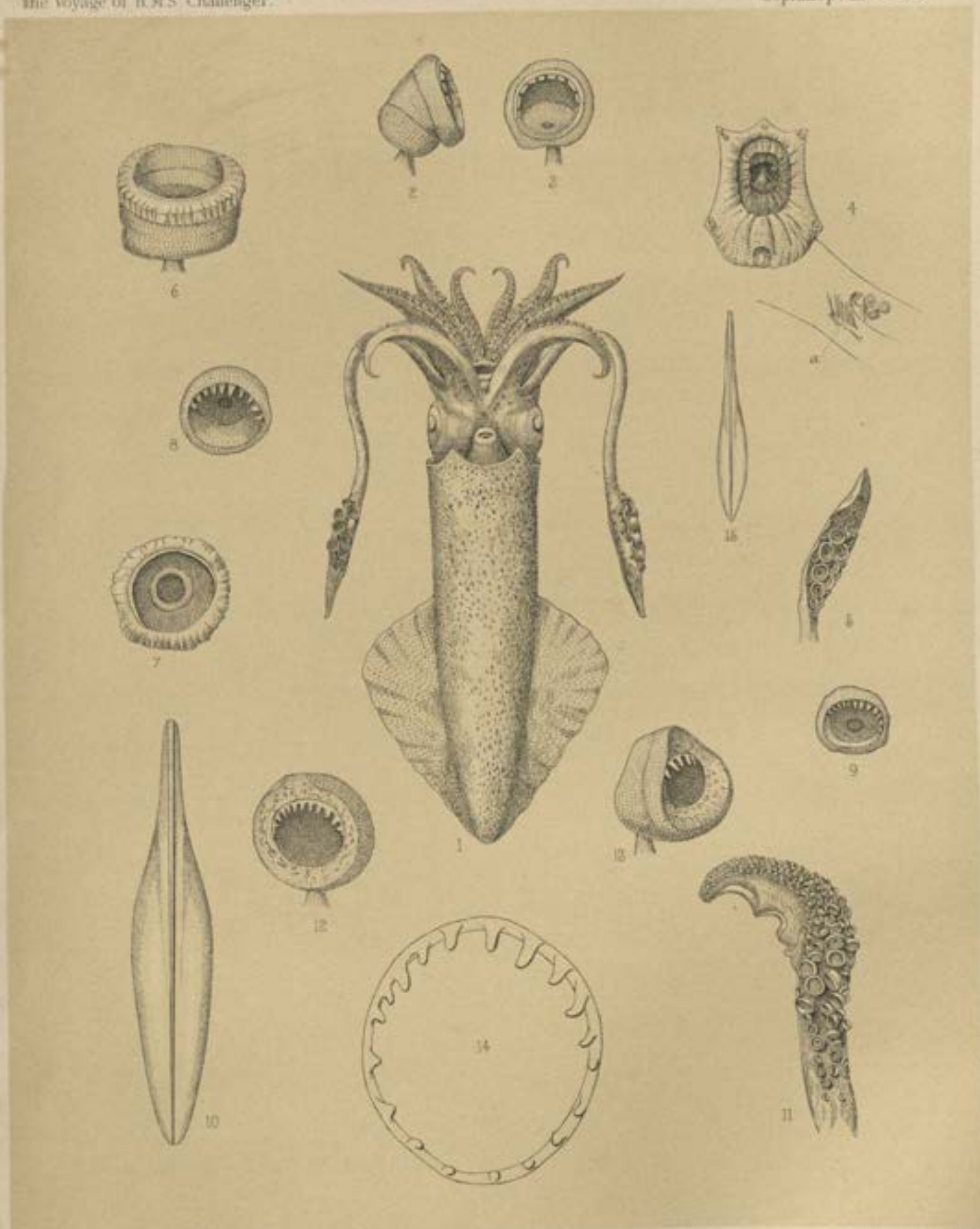
Fig. 11. The left tentacular club; magnified 7 diameters.

Fig. 12. Front view of a median tentacular sucker; magnified 40 diameters.

Fig. 13. Oblique view of a similar sucker; magnified 40 diameters.

Fig. 14. The horny ring of a similar sucker; magnified 200 diameters.

Fig. 15. The gladius; natural size.



1–10. LOLIGO KOBIENSIS, n. sp. 11–15. LOLIGO ELLIPSURA, n. sp.

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LOLIGO INDICA, Pfeffer, ... 156

Fig. 1. Ventral aspect of the largest specimen; natural size.

Fig. 2. Dorsal aspect of the head; natural size.

Fig. 3. Front view of a sucker, from one of the sessile arms; magnified 20 diameters.

Fig. 4. Side view of the same sucker; magnified 20 diameters.

Fig. 5. A median tentacular sucker; magnified 20 diameters.

Fig. 6. The right tentacular club; magnified 7 diameters.

Fig. 7. The horny ring of a median tentacular sucker; magnified 20 diameters.

Fig. 8. A terminal tentacular sucker; magnified 20 diameters.

Fig. 9. A lateral tentacular sucker; magnified 20 diameters.

Fig. 10. The gladius of a smaller specimen; natural size.

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LOLIGO INDICA, Pfeffer.

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LOLIGO GALATHEÆ, Steenstrup, 159

Fig. 1. Dorsal view of a male specimen; natural size.

Fig. 2. Suckers from one of the sessile arms of the same individual; enlarged.

Fig. 3. Side view of a sucker, from the proximal third of the third left arm; magnified 70 diameters.

Fig. 4. Front view of the same sucker; magnified 70 diameters.

Fig. 5. The hectocotylised arm of the individual shown in fig. 1; magnified 2 diameters.

Fig. 6. Two pairs of papillæ from about halfway up the arm; enlarged.

Fig. 7. A papilla with a very small sucker at its tip; enlarged.

Fig. 8. A papilla whose sucker has entirely disappeared; enlarged.

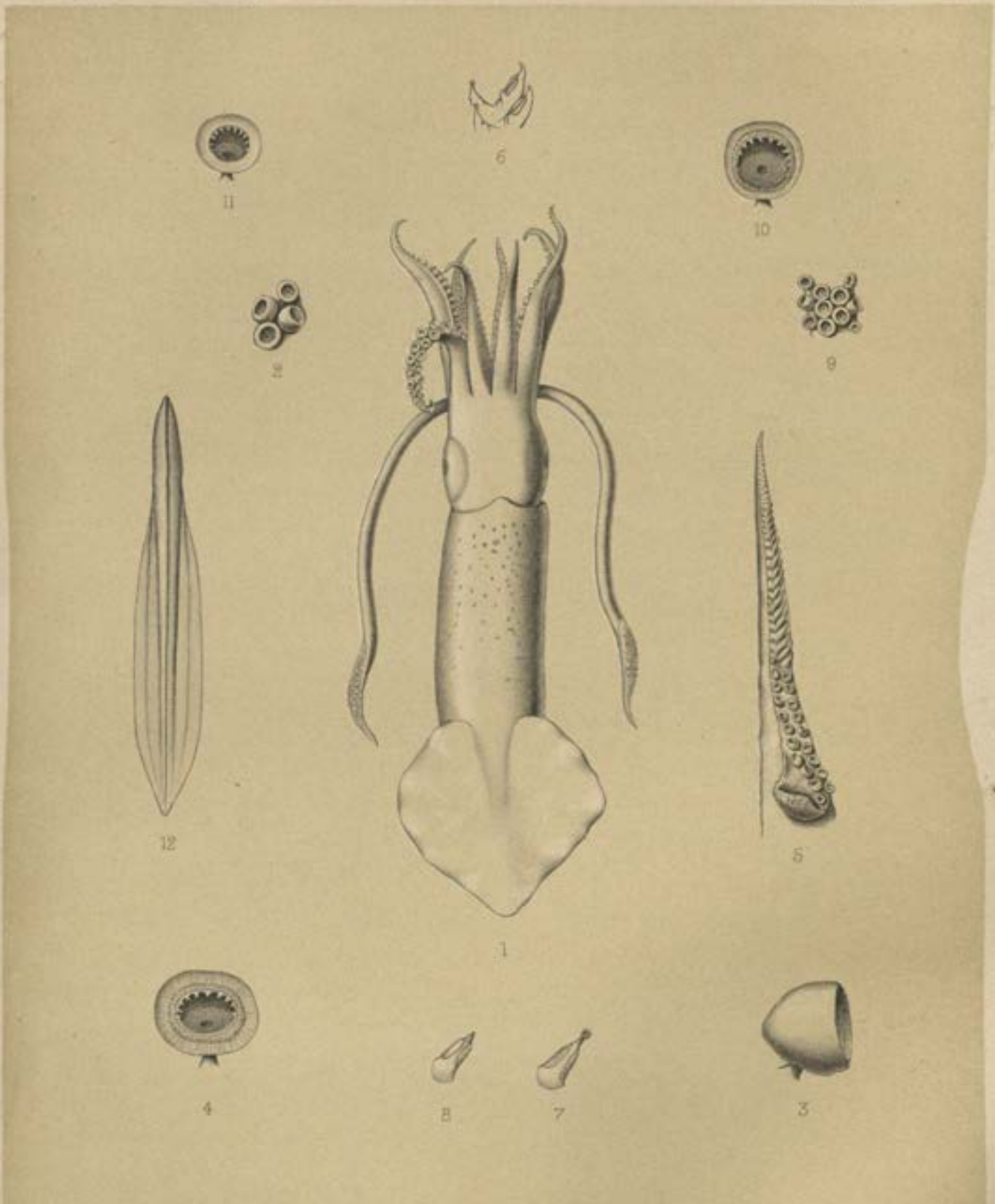
Fig. 9. A portion of the tentacular club; magnified 2 diameters.

Fig. 10. A median tentacular sucker; magnified 30 diameters.

Fig. 11. A lateral tentacular sucker; magnified 30 diameters.

Fig. 12. The gladius; natural size.

Figs. 1, 2, 5, 6, 7, 8, 9, 12 were drawn by Mr. Thornam from a specimen in the Copenhagen Museum; the remainder are from the immature Challenger specimens.



LOLIGO GALATHEÆ, Stp.

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Figs. 1–5. TODARODES PACIFICUS, Steenstrup, 168

Fig. 1. Dorsal aspect of a female specimen; two-thirds the natural size.

Fig. 2. The third right arm; magnified 1·5 diameter.

Fig. 3. Two suckers from about one-third up the same arm; magnified 4 diameters.

a. A portion of the horny ring still more enlarged.

Fig. 4. The left tentacular club; natural size.

Fig. 5. Two median tentacular suckers; magnified 2 diameters.

All the above figures were drawn by Mr. Thornam from a specimen in the Copenhagen Museum.

Figs. 6–12. TRACHELOTEUTHIS RIISEI, Steenstrup, 164

Fig. 6. Dorsal view of the specimen; natural size.

Fig. 7. Ventral aspect of the siphon; magnified 2 diameters.

Fig. 8. A sucker from one of the sessile arms; magnified 60 diameters.

Fig. 9. The tentacular club; magnified about 7 diameters.

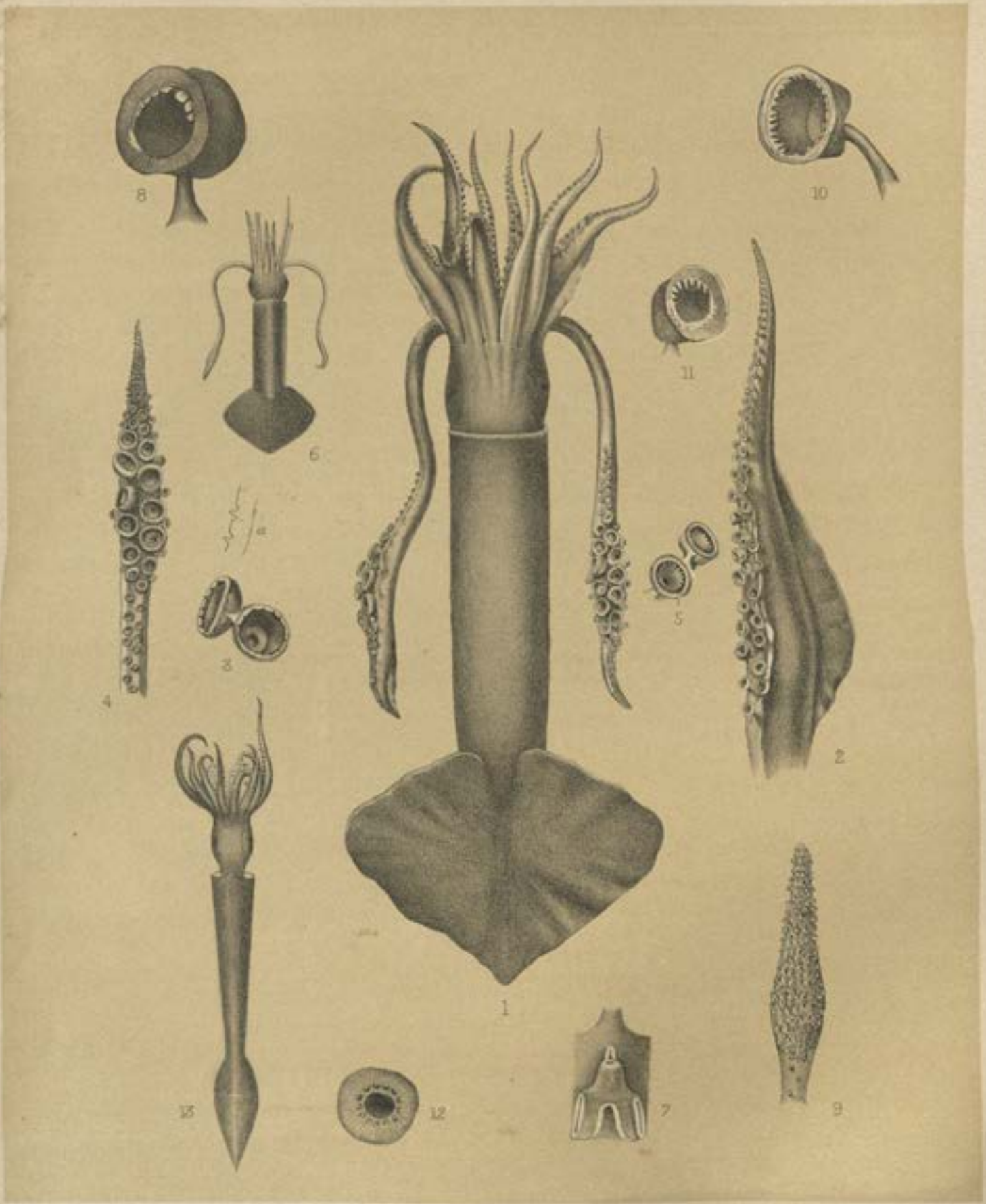
Fig. 10. A large tentacular sucker; magnified 60 diameters.

Fig. 11. A terminal tentacular sucker; magnified 100 diameters.

Fig. 12. A small tentacular sucker; magnified 250 diameters.

Fig. 13. TAONIUS ELONGATUS, Steenstrup, 189

Fig. 13. Dorsal view of the type specimen; one-fourth the natural size. From a sketch by Mr. Thornam.



1–5. TODARODES PACIFICUS, Stp. 6–12. TRACHELOTEUTHIS RIISEI, Stp.
13. TAONIUS ELONGATUS, Stp.

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Figs. 1–7. BATHYTEUTHIS ABYSSICOLA, n. gen., n. sp., . . 168

Fig. 1. Dorsal view of the specimen; natural size.

Fig. 2. View of the ventral aspect of the siphon, to show the mantle-connective; somewhat enlarged.

Fig. 3. Anterior aspect of the arms and circumoral region; magnified 3 diameters.

Fig. 4. A sucker from one of the sessile arms; magnified 200 diameters.

Fig. 5. The extremity of the left tentacle; magnified 10 diameters.

Fig. 6. A tentacular sucker; magnified 200 diameters.

Fig. 7. The gladius; natural size. The dotted line indicates the presumed outline of the damaged posterior extremity.

Figs. 8–10. MASTIGOTEUTHIS AGASSIZII, Verrill, . . 170

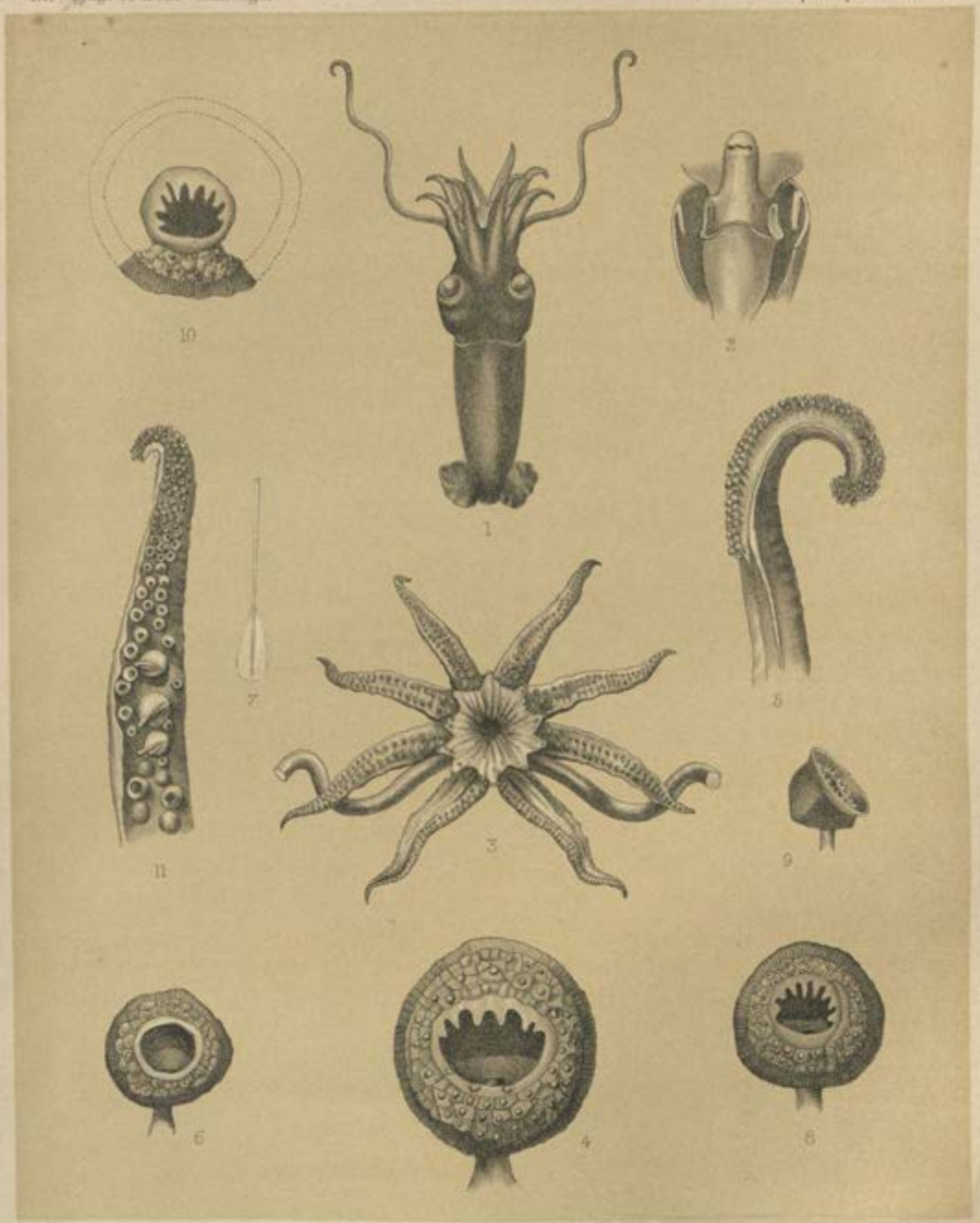
Fig. 8. Front view of a tentacular sucker; magnified 60 diameters.

Fig. 9. Side view of a similar sucker; magnified 30 diameters.

Fig. 10. Part of a front view of a similar sucker, to show the form of the horny ring and the papillary area.

Fig. 11. ENOPLOTEUTHIS MARGARITIFERA, Rüppell, . . 171

Fig. 11. The left tentacular club; magnified 25 diameters.



1–7. BATHYTEUTHIS ABYSSICOLA, n. gen. n. sp. 8–10. MASTIGOTEUTHIS AGASSIZII, Vill.*
11. ENOPLOTEUTHIS MARGARITIFERA, Rupp.

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Figs. 1–8. TELEOTEUTHIS CARIBBÆA (Lesueur), . . 172

Fig. 1. The tentacular club; magnified.

Fig. 2. A large marginal sucker.

Fig. 3. A terminal sucker; very highly magnified.

Fig. 4. A median sucker from the second transverse row, showing the incipient hook.

Fig. 5. A similar sucker, but slightly further up the club, showing a longer hook.

Fig. 6. Front view of a median hook.

Fig. 7. Side view of a similar hook.

Fig. 8. A similar hook, viewed from above.

Figs. 9–15. HISTIOPSIS ATLANTICA, n. gen., n. sp., . . 180

Fig. 9. Ventral aspect of the specimen; natural size.

Fig. 10. Dorsal aspect of the specimen; natural size.

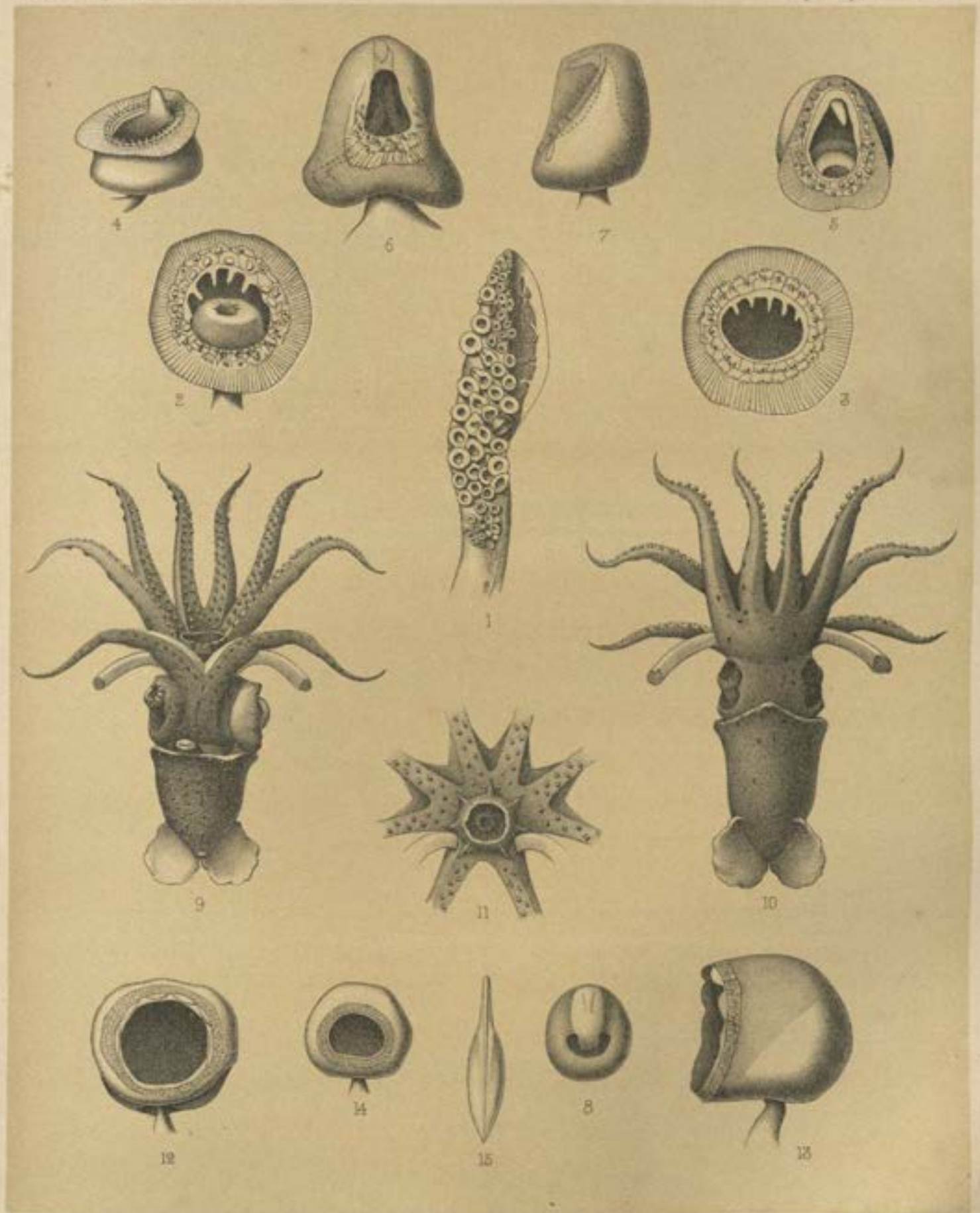
Fig. 11. Circumoral region, showing the buccal membrane and the bases of the arms and tentacles; natural size.

Fig. 12. Front view of the larger suckers, from the distal half of the arms.

Fig. 13. Side view of the same sucker.

Fig. 14. One of the smaller suckers, from the proximal part of the arm.

Fig. 15. The gladius; natural size.



A. Pollack, del. McFarlane & Erskine, Lith. Edin.

1–8. TELEOTEUTHIS CARIBBÆA (Lesr) 9–15. HISTIOPSIS ATLANTICA, n. gen., n. sp.

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Figs. 1–5. CHIROTEUTHIS (?) sp., . . . 178

Fig. 1. Side view of a portion of the pen; natural size.

Fig. 2. Dorsal view of a portion, anterior to the last; natural size.

Fig. 3. Section through the anterior part of fig. 1; natural size.

Fig. 4. Section through another portion situated some distance behind that shown in fig. 1; natural size.

Fig. 4*a*. Section through the anterior part of fig. 2; natural size.

Fig. 5. Section through the extremity of the smallest portion in the collection; natural size.

Figs. 6–10. TRACHELOTEUTHIS (?) sp., . . 166

Fig. 6. Dorso-lateral view of a specimen, which had been mounted as a microscopic object, and was much compressed; magnified 4 diameters.

Fig. 7. Similar view of another specimen, which had been preserved in alcohol; magnified 4 diameters.

Fig. 8. Dorsal aspect of the head, showing the prominent lip between the arms; magnified 7 diameters.

Fig. 9. Ventral view of the siphon, showing the pits for articulation with the mantle; magnified 20 diameters.

Fig. 10. The posterior extremity, showing the form of the pen and the fins; magnified 4 diameters.

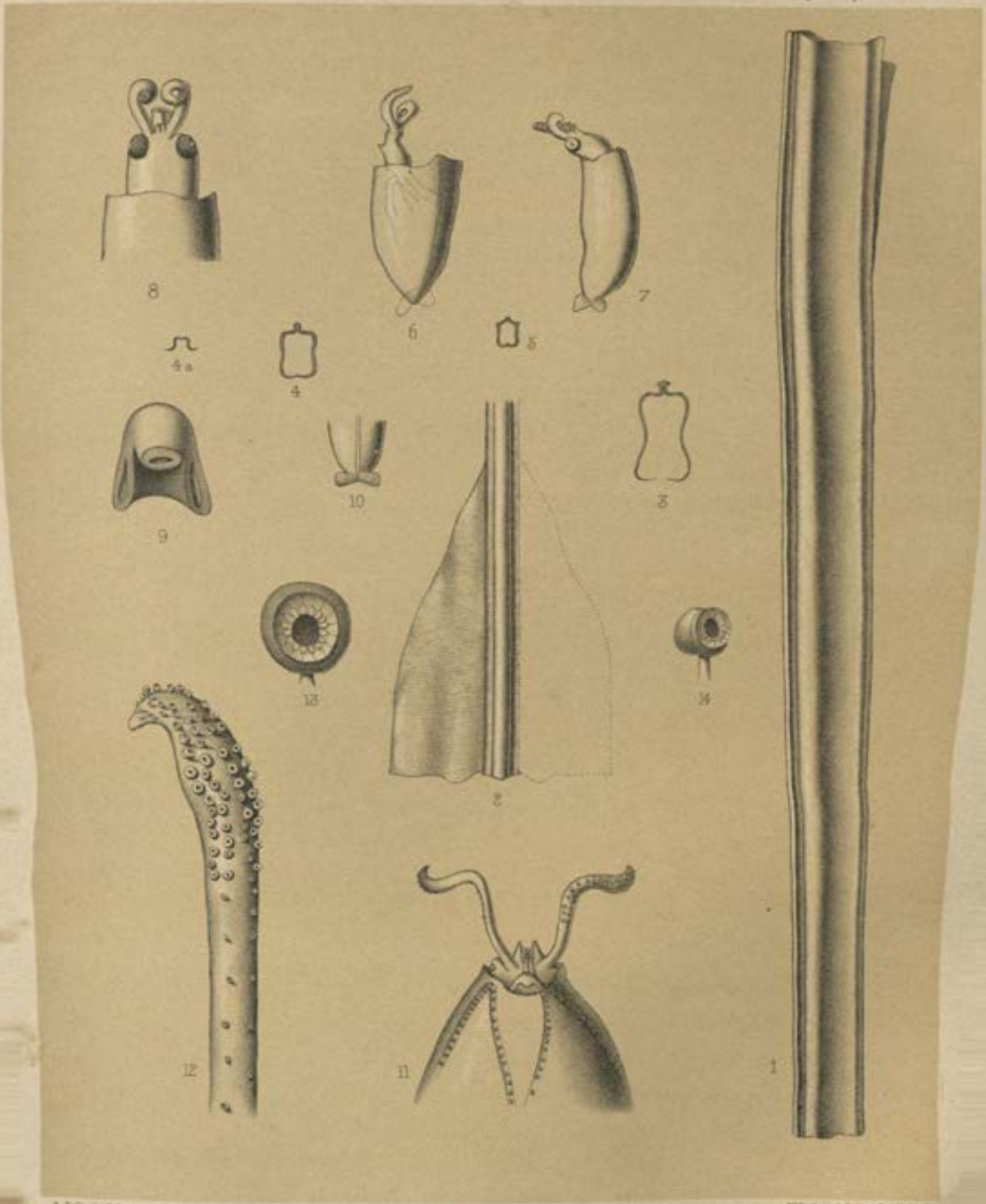
Figs. 11–14. CRANCHIA REINHARDTII, Steenstrup, . . 184

Fig. 11. Ventral aspect of the head and anterior part of the mantle; magnified 4 diameters.

Fig. 12. The extremity of the tentacle; magnified 20 diameters.

Fig. 13. One of the larger suckers from the tentacle; magnified 200 diameters.

Fig. 14. One of the smaller suckers from the tentacle; magnified 200 diameters.



A. Pollock, del.

McFarlane & Erskine Lith.

1–5. CHIROTEUTHIS (?) sp. 6–10. TRACHELOTEUTHIS (?) 11–14. CRANCHIA REINHARDTII. Stp.

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Figs. 1–4. CRANCHIA REINHARDTII, Steenstrup, . . 184

Fig. 1. Anterior aspect of the head and arms; magnified 7 diameters.

Fig. 2. Dorsal view of the posterior extremity of the body, showing the form of the fin; magnified about 3 diameters.

Fig. 3. Lateral aspect to show the form of the end of the body; magnified about 3 diameters.

Fig. 4. A specimen showing a tapering posterior extremity to the body; slightly enlarged.

Figs. 5–11. TAONIUS SUHMI (Lankester), . . . 192

Fig. 5. Ventral aspect of one of the specimens; natural size.

Fig. 6. A sucker from one of the sessile arms; considerably enlarged.

Fig. 7. One of the median tentacular suckers; magnified 30 diameters.

Fig. 8. The horny ring of a similar sucker; magnified 30 diameters.

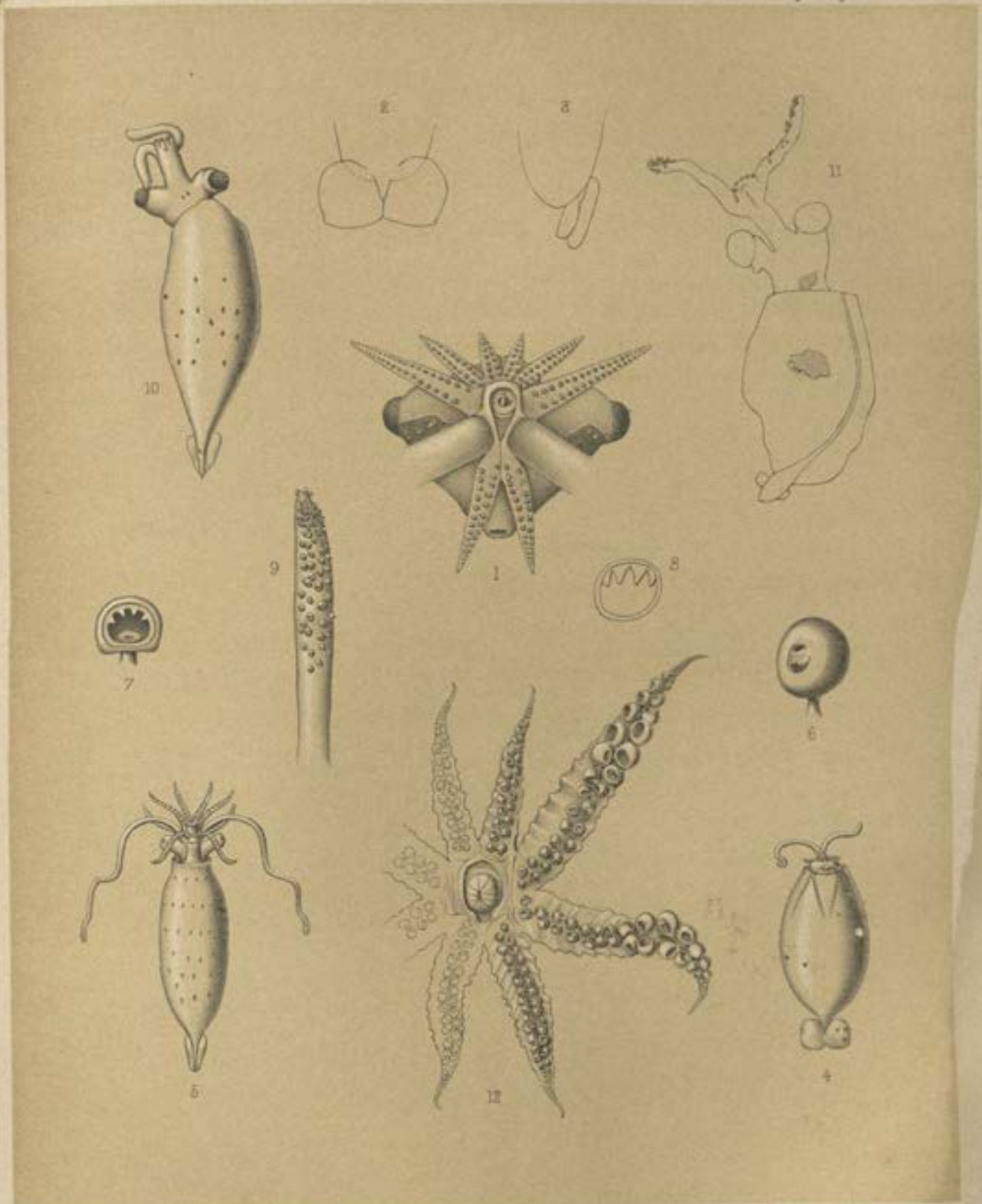
Fig. 9. The extremity of the tentacle; magnified 8 diameter.

Fig. 10. A specimen from the Atlantic Ocean, preserved in alcohol; magnified 8 diameters.

Fig. 11. The "complete" specimen, drawn from a microscopic preparation of Dr. v. Willemoes-Suhm; magnified 8 diameters.

Fig. 12. TAONIUS HYPERBOREUS, Steenstrup, . . 191

Fig. 12. Anterior view of the arms and circumoral region, showing the enlarged suckers on the lateral arms; the dorsal aspect is downwards; natural size. Drawn by Mr. Thornam from the type specimen in the Copenhagen Museum.



1-4. CRANCHIA REINHARDTII, Sep. 5-11. TAONIUS SUHMI (Lankester)

12. TAONIUS HYPERBOREUS, Sep.

PLATE XXXIII.

PLATE XXXIII.

PAGE

Figs. 1–11. TAONIUS HYPERBOREUS, Steenstrup, 191

Fig. 1. Dorsal view of the type specimen; one-half natural size.

Fig. 2. Front view of an enlarged sucker, from one of the lateral arms; magnified 4 diameters.

Fig. 3. Side view of the same sucker; magnified 4 diameters.

Fig. 4. Front view of a similar sucker; less enlarged.

Fig. 5. Side view of the same sucker as fig. 4; less enlarged.

Fig. 6. The inner aspect of the tentacular club; natural size.

Fig. 7. A portion of the stem; enlarged to show the suckers and fixing-cushions.

Fig. 8. Three views of a large tentacular sucker; somewhat magnified.

Fig. 9. Front view of a similar sucker; magnified about 10 diameters.

Fig. 10. A sucker and fixing-cushion from the stem of the tentacle; magnified about 30 diameters.

Fig. 11. The gladius of a smaller specimen from the "Porcupine" collection; natural size.

Figures 1, 4, 5, 6, 7, 8, were drawn by Mr. Thornam from the type specimen in the Copenhagen Museum.

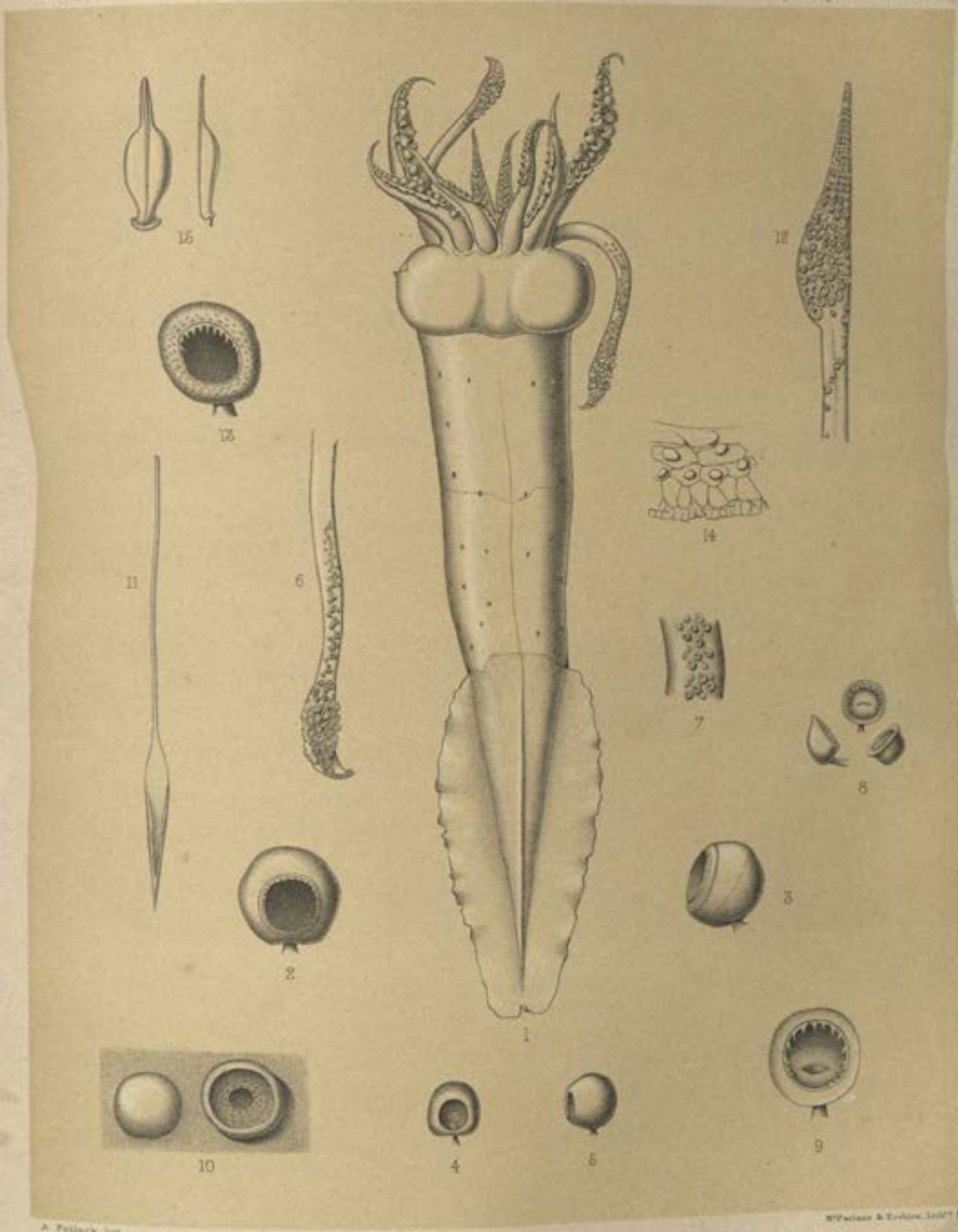
Figs. 12–15. CALLITEUTHIS REVERSA, Verrill, 183

Fig. 12. The right tentacular club; magnified about 5 diameters.

Fig. 13. One of the larger tentacular suckers; magnified 40 diameters.

Fig. 14. A portion of the horny ring and papillary area; magnified 250 diameters.

Fig. 15. Dorsal and lateral views of the gladius; natural size.



A. Pollock, lith.

W. Patterson & Erskine, Lith^rs Edin^r

1–11, TAONIUS HYPERBOREUS, Sup. 12–15, CALLITEUTHIS REVERSA, Vil.

A
B
C
V
VI
VII
VIII
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X
XI
XII
XIII
XIV
XV

THE

VOYAGE OF H.M.S. CHALLENGER.

ZOOLOGY.

REPORT on the STOMATOPODA collected by H.M.S. Challenger during the Years 1873-76. By W. K. BROOKS, Associate Professor of Zoology and Director of the Marine Laboratory of the Johns Hopkins University, Baltimore, U.S.A.

INTRODUCTION.

THE Stomatopoda are restricted to shallow waters, and as the small collection which was brought home by the Challenger, and entrusted to me for examination, contains no startling novelties, my first feeling, after my preliminary examination, was disappointment at the absence of any unfamiliar type, but this soon gave way to a feeling of excited interest after the discovery that the material in my hands furnished the most ample opportunities for tracing out, with great completeness, the phylogenetic and ontogenetic history of this small and compact order of Malacostraca.

The order Stomatopoda includes about sixty species of adults, and an equal or greater number of larvæ, from the tropical, subtropical, and temperate waters of the Atlantic, Pacific, and Indian Oceans. Some of the species, like *Gonodactylus chiragra*, range over the whole of this area, while others, like *Squilla nepa*, are distributed over the bottoms between the coast of Chili on the one side and the coasts of China and Africa on the other, or like *Squilla empusa*, between Rhode Island, U.S.A., and Africa. They are usually found in very shallow water, and, with the exception of the specimen of *Squilla leptosquilla* taken in the trawl by the Challenger in the Celebes Seas from a depth of 115 fathoms, and a specimen of *Lysiosquilla armata* which S. I. Smith found in the stomach of a *Lopholatilus* from 120 fathoms, they are all from very moderate depths, and the wide distribution of many of the species is undoubtedly due to the great length of their

larval life, during which they swim at the surface and are swept to great distances by the oceanic currents.

There are, however, many species which are known from only a single restricted locality, and almost one-fourth of the species which have been described are represented by solitary specimens, and there is therefore every reason to believe that many species, and possibly many genera, are still unknown, and that our knowledge of the group is very incomplete. They are extremely active in their movements and retiring in their habits, and they may remain undiscovered in a locality where they are abundant. A few species are recorded as dwelling in crevices in coral reefs, but most of them are burrowing animals. The living animals which form their prey are captured in the long raptorial claws, and some species, like *Squilla empusa*, often venture to a great distance from their burrows in their pursuit of prey, and are frequently captured in nets and trawls, although others, such as *Lysiosquilla excavatrix*, are the Myrmeleons of the ocean, lying in wait for their prey, covered with sand, with only the tips of their eyes exposed, at the mouths of their very deep burrows, to the bottoms of which they dart at the least alarm. At Beaufort, N.C., *Lysiosquilla excavatrix* is so abundant that the mouths of several burrows may often be found in shallow water in a square yard of the bottom, yet during the six summers I have passed there, I have obtained only one adult specimen which was captured outside its burrow, and only one which was obtained by digging. It was not until I devised the plan of holding near the mouth of the burrow with one hand a piece of bait, such as a small fish or a crushed crab, while the other hand was held ready with a trowel to cut off the retreat to the bottom of the burrow, that I was able to procure them in abundance, and the movements of this species are so very rapid that most of the specimens were so near escaping that they were cut in two when the trowel was plunged into the ground.

The Challenger collection of adults is a very small one, consisting of only fifteen species, but eight of them are new, while two of the others, *Squilla fasciata* and *Protosquilla* (*Gonodactylus*) *guerinii*, have been very inadequately described from single specimens. The importance of the collection must not, however, be estimated by its size, for it throws light upon many interesting problems, and furnishes the material for a more exhaustive and satisfactory discussion of the phylogenetic relationship and the natural classification of the various genera and species than has been possible hitherto.

The collection of pelagic Stomatopod larvæ is very rich, and it has yielded the material for tracing the history of several of the larval types, and also for establishing, in every genus except one, the connection between the adults and their larval types.

The larval history of the Stomatopoda is one of the most puzzling problems in morphology, and most of our knowledge of the subject is derived from Claus's well-known memoir.[1]

[1] Die Metamorphose der Squilliden, *Abhandl. d. k. Gesellsch. d. Wiss. Göttingen*, Bd. xvi. pp. 1–55, pls. i.–viii., 1871.

While I have been able to show, from the study of the Challenger specimens, that many of Claus's conclusions are incorrect, and that he referred some of the most familiar larval types to the wrong adult genera, I feel that I could not have accomplished this alone, and that, while my results are in many cases directly opposite to his conclusions, my ability to reach and to prove them is due, in a very great degree, to the study of his memoir. The labour of tracing the history of the larvæ has been so simplified through the accurate illustrations and ample and minute descriptions which he has furnished, that the investigator who follows him in this field has much of the difficulty removed, and, while I feel that I leave the subject in a much more satisfactory condition than that in which I found it, I also feel that I could not have made the same progress without the aid of his memoir.

The beautiful transparent, glass-like pelagic larvæ of the Stomatopoda are familiar to all naturalists who have had an opportunity to study pelagic life, and none of the animals which are captured at the surface in the tow-net exceed them in interest to the student, or in beauty and grace. Their perfect transparency, which allows the whole of their complicated structure to be studied in the living animal, their great size and rapacity, the graceful beauty of their constant and rapid movements, and the profundity of the morphological problems which they present for solution, cannot fail to fascinate the naturalist. Unfortunately they are as difficult to study as they are beautiful and interesting, and, notwithstanding their great abundance and variety, only two or three of them have been traced to their adult form.

Unlike most Malacostraca, the Stomatopods, instead of carrying their developing eggs about with them, deposit them in their deep and inaccessible burrows under the water, where they are aerated by the currents of water produced by the abdominal feet of the parent, which are so shaped as to form valves or paddles which exactly conform to the outline of the cylindrical hole. The eggs quickly perish when deprived of this constant current, and as it is very difficult to procure them at all, I know of no young Stomatopod which has been reared from an egg outside the burrow or in an aquarium. The older larvæ are hardy, and they thrive in small aquaria and moult into the adult form, but they are seldom found near the shore, and microscopic research is so difficult in mid ocean that almost nothing has been accomplished in this way. The younger larvæ are common near the shore, but they seldom pass through a moult in confinement, and the only way to trace the life-history of the Stomatopoda is therefore by the comparison of the series of larvæ which are collected in the ocean, and this is attended with peculiar difficulties, for the number of larval forms which have been described is much greater than the number of adults which are known, and many of them unquestionably belong to unknown species, and possibly to unknown genera.

The growth of the larvæ is very slow, and the larval life long, and as they are as independent and as much exposed to changes in their environment, and to the struggle

for existence as the adults, they have undergone countless secondary modifications which have no reference to the life of the adult, and are therefore unrepresented in the adult organism; and a comparison of the various larvæ which are here figured and described will show that they differ among themselves more than the adults, thus reversing the general rule that larvæ are less specialised and exhibit clearer evidence of genetic relationship than mature animals. The problem which they present is very similar to, but more difficult than, that presented by the Hydro-medusæ, for young Medusæ can be reared from the hydroids in aquaria without difficulty, and it is also easy to rear young hydroids from the eggs of Medusæ, but the life-history of the Stomatopoda must be traced from the internal and indirect evidence furnished by comparison.

The Stomatopod larvæ present differences among themselves, and they may be arranged in genera and species, but unfortunately their generic characteristics are quite different from those upon which the adult genera are based, and this is true in a still greater degree of their specific characteristics. As the larvæ undergo great changes during their growth, different stages have been described as distinct species or even genera, and it is not easy to select from the rich gatherings which are brought home by collectors, the successive stages in the history of a single species. Like the adults, they are widely distributed, and a gap in a series from the North Atlantic may be filled by a specimen from the coast of Australia or the Sandwich Islands, and the collection from a single locality may contain the larvæ of several widely separated species of adults in all stages of growth.

The attempt to unravel the tangled thread of the larval history of the Stomatopoda is therefore attended with very exceptional difficulties, and the earlier writers were content to rest after the bestowal of generic and specific names upon the larvæ, and the first writer to approach the subject in a scientific spirit was Claus, whose classical monograph not only abounds in fundamental generalisations of the greatest interest and value, but also contains nearly all that we know regarding the relationship between the larvæ and their adults; but the Challenger collections, especially the rich collections of *Alima* larvæ, a group in which Claus's collections were very deficient, furnish the material for revision of the subject, and enable us to determine, with much greater certainty than before, the larval type which pertains to nearly every one of the genera of adult Stomatopoda, and also to give a pretty complete picture of the developmental history of each larval type. As the specific differences between the adults are very slight, the specific identity of each larva can be determined only by rearing the adult from the larvæ, but this fact renders it the more important that the series collected by the Challenger should be figured and described, as later investigators will thus be enabled to complete the history by keeping the final stage in each series alive in an aquarium until it assumes the characteristic of the adult. This can be done without difficulty, as the older larvæ are hardy, while the fact that the younger larvæ will not live in captivity

frustrates the attempt to trace the gradual growth and metamorphosis of the larvæ in this way, and there is no other resource except comparison.

The first step in this direction is to trace the history of each larval type, by the selection and comparison of those larva which belong to the same series. In accomplishing this I have been guided in part by general resemblances, but more especially by comparative measurements. After I had tabulated the measurements in millimetres of a number of specimens, which resembled each other quite closely, and formed a tolerably complete series, I failed at first to trace through the columns of the table any such conformity to a general law as I had expected, but more careful examination indicated that this might be due to the fact that the history of the larva consists of metamorphosis as well as growth, and that the size of one organ might, when compared with that of another organ, show a gradual decrease during the successive stages, while its absolute size was actually increasing. I therefore reduced all my measurements to a common standard, and expressed them in thousandth parts of the total length of the larva at each stage instead of in millimetres, and I found that this at once introduced order where all had before been confused, and that, when thus reduced, the measurements usually enabled me to decide with confidence whether a given larva does or does not belong to a certain series.

In a few cases these comparative measurements gave proofs of specific identity which could hardly be made more conclusive by rearing the larvæ. Thus the lengths of the series of *Coronis* larvæ shown in Pl. XIII. figs. 1–8 are as follows, and if the length of the first stage be successively multiplied by five-fourths of itself, and this number by five-fourths of itself again, and so on, we obtain the series of numbers given in the second line, and as it is not conceivable that an accidental collection of larvæ should exhibit such exact conformity to a numerical law, we may feel certain that these larvæ are genetically related, that they belong to one species or else to closely related species, and that the series is consecutive, with the exception of one missing stage before the last.

4·16 mm.	5·29 mm.	6·49 mm.	...	10·21 mm.
4·16 „	5·20 „	6·50 „	8·13 mm.	10·16 „

After one or two series had been traced out in this way, the general character of the metamorphosis itself became a trustworthy guide for establishing the series for a closely related species, and thus simplified the labour, and the next step was the reference of each larval type to its proper adult genus.

If the differences between the larvæ are due to secondary modification, we should not expect the larvæ of two distinct adults to become modified in the same way, and although it is of course possible that the larvæ of two closely related adults might

become divergently modified, or that two adults might diverge from each other while the larvæ remain alike, yet we should expect a natural or phylogenetic classification of the larvæ to stand in some definite and recognisable relation to the natural classification of the adults.

My attempt to discover a relation of this sort at once brought me face to face with a serious difficulty. In most of the published descriptions little attention is given to any points which are not regarded as diagnostic, and the resemblances, which are of even greater scientific interest than the differences, are often completely neglected; and careful study of the published figures soon showed that they are untrustworthy so far as relates to points which did not seem significant to the writers. Brevity and exactness of diagnosis is of course desirable and essential to the ready identification of species, but the description and identification of species is only a means for a more important end, the ultimate discovery of the laws of life, and it is therefore desirable that every specific description should consist of two parts, a brief diagnosis for purposes of identification, and a complete description, or brief monograph, giving all the characteristics; the points of resemblance to allied forms, as well as the distinctive peculiarities.

The absence of this information renders the establishment of phylogenetic relationships very difficult, and I soon found that the characteristics which are most significant and of most scientific importance are by no means the ones which have been selected for diagnosis. The analytical key which Miers[1] gives is probably the best which could be devised for ease of identification, and it expresses the general relationship between the genera with sufficient accuracy for the purposes of the systematist; but while most of the genera which are usually recognised are natural ones, the points which are of the greatest value in tracing the relation between the larvæ and the adults are entirely ignored in most of the published diagnoses.

While there can be no doubt that the many differences between the Stomatopoda and the other Malacostraca are of ordinal importance, all the species are included in a single family, the Squillidæ, and the differences between the genera are slight. Excluding the genus *Leptosquilla*, Miers, which is very slightly known, and not represented in the Challenger collection, six genera are usually recognised, *Squilla*, *Chloridella*, *Lysiosquilla*, *Coronis*, *Pseudosquilla*, and *Gonodactylus*.

The study of the Challenger specimens shows the necessity for redistributing the species which have been associated under the generic name *Gonodactylus*, and the establishment in its place of three genera, *Gonodactylus* (*sensu stricto*), *Protosquilla* n. gen., and *Coronida* n. gen., and also that it is impossible to draw any natural line between *Coronis* and *Lysiosquilla*, or between *Chloridella* and *Squilla*, and I therefore recognise seven genera, *Protosquilla*, *Gonodactylus*, *Pseudosquilla*, *Coronida*, *Lysiosquilla* (including *Coronis*), and *Squilla* (including *Chloridella*). My comparison of the

[1] On the Squillidæ, *Ann. and Mag. Nat. Hist.*, ser. 5, vol. v. p. 2, 1880.

adults with the larvæ shows that the marginal spines of the telson present features which are of the greatest significance, and as I shall make frequent reference to these structures it will be convenient to give in this place a short description of them. The telson of a Stomatopod is usually furnished with six marginal spines (see Pl. I. fig. 3), which are arranged in three pairs, and which I shall designate as the primary marginal spines. The two nearest the middle line are the submedians; the two nearest the anterior edge, usually the farthest from the middle line, are the laterals; and the one between the lateral and the submedian on each side is the intermediate. Between these six primary marginal spines there are others which are equally large and prominent in the young larvæ, but minute or absent in the adults; these I call the secondary marginal spines.

Analytical Key, giving the more prominent Diagnostic Characteristics of each Genus.

I. Sixth abdominal somite fused with telson; rostrum with acute median and antero-lateral spines.

a. Dactyle of raptorial claw dilated at the base and unarmed; hind body narrow and thick; marginal spines of telson crowded towards posterior edge.

Genus *Protosquilla* (Pl. XVI.).

II. Sixth abdominal somite distinct; rostrum without antero-lateral spines.

a. Hind body narrow and thick.

1. Dactyle of raptorial claw dilated at base, and unarmed; primary marginal spines of telson very large, with one or two secondary spines on each side between the submedian and the intermediate.

Genus *Gonodactylus* (Pl. XIV. fig. 1).

2. Dactyle of raptorial claw not dilated at base, usually armed with marginal spines; submedian spines of telson tipped with movable spinules; from one to three secondary spines between the submedian and the intermediate.

Genus *Pseudosquilla*.

b. Hind body depressed and wide.

1. Dactyle of raptorial claw dilated at the base and armed with marginal spines.

Genus *Coronida*.

2. Dactyle of raptorial claw not dilated at the base, but usually armed with marginal spines.

(1) Primary marginal spines of telson small, with no more than four secondary spines between the submedian and the intermediate; outer spine of basal prolongation of uropod usually longer than the inner; dactyle of raptorial claw with not less than six marginal spines.

Genus *Lysiosquilla* (Pl. X. figs. 8–16).

(2) Primary marginal spines of telson large, with more than four secondary spines between the intermediate and the submedian; inner spine of basal prolongation of uropod longer than outer; dactyle of raptorial claw usually with no more than six marginal spines.

Genus *Squilla* (Pls. I., II., III.).

In each of these genera there are certain characteristic or typical species, which are sharply cut off from all other genera, but it is difficult to give any absolutely diagnostic generic characteristics, as, in addition to the divergent and typical species, each genus also contains a few species which are more primitive, with the characteristics of the genus very slightly developed, and with features of resemblance to the primitive species in other genera.

The form of the dactyle of the raptorial claw affords a ready means for distinguishing species, and most of the genera are based upon peculiarities of this organ, which furnishes a tolerably satisfactory index of relationship, but gives no clue to the wider and more deep-seated affinities; but as soon as we ignore the preponderating importance which has been attached to the big claw, and take the whole organisation into consideration, we find that there are, in each genus, species which exhibit evidences of relationship to a common type or ancestral form, from which the various genera have diverged, and which was characterised by the possession of small, subcylindrical eyes, an acutely pointed rostrum, a smooth hind body, a short wide smooth carapace, very small antennary scales and uropods, and a telson which was wider than long, with the marginal spines crowded backwards, and the posterior border transverse, or nearly so.

From this primitive form, which is represented at the present day, probably with slight secondary modifications, by the various species which I have associated under the generic name *Protosquilla*, the various genera have diverged, and while it is not at all probable that any species which we know is the actual stem form of the order, yet there is ample evidence to show that this was characterised by the features which the various species of *Protosquilla* have in common, and that it must have been more nearly allied to them than to any other species with which we are acquainted. Thus, for instance, the

more typical species of the genus *Squilla*, such as *Squilla nepa*, have broad triangular eyes, an elongated carinated carapace with acute spines at its antero-lateral angles, longitudinal carinæ on all the abdominal somites, the appendages of the exposed thoracic legs filiform, and the telson longer than wide, with well-developed marginal spines, of which only the submedians are on the posterior border, and the others lateral. In *Squilla lata* (Pl. III. figs. 1, 2, 3) the eyes are narrow and only slightly enlarged at their tips, the appendages of the exposed thoracic limbs are flat, and the submedian carinæ are absent or obsolete on the first five abdominal and all the thoracic somites. In *Squilla fasciata* (Pl. III. figs. 4, 5) the eyes are cylindrical, not at all dilated at the tips, the appendages of the exposed thoracic limbs are flat and strap-shaped, and the submedian dorsal carinæ are completely absent on the first five abdominal somites; while in *Squilla chlorida* (Pl. II. figs. 1–5), which is not usually regarded as a *Squilla*, but is placed in a distinct genus *Chloridella*, the eyes are constricted at the tips, the appendages of the exposed thoracic appendages broad and flat, and the submedian carinæ absent from all the exposed somites except the sixth abdominal; and in *Squilla* (*Chloridella*) *microphthalma* the eyes and appendages are like those of *Squilla chlorida*, but the dorsal surfaces of the exposed somites are smooth, and their lateral edges but faintly carinated, and the telson is wider than long, and the uropods small. In all these species the antero-lateral angles of the carapace are acute, but in *Squilla* (*Chloridella*) *rotundicauda* we have, in addition to the wide telson the small uropods and eyes and antennary scales of *Squilla microphthalma*, a loosely articulated hind body, a carapace which is rounded in front as well as behind, and the posterior margin of the telson rounded.

The series is so complete that it is quite impossible to draw any line to separate the genus *Squilla* from the genus *Chloridella*, and all the species must therefore be associated in a single genus *Squilla*. It is easy to find an answer to the question, which term in the series of species of *Squilla* is most primitive, for while the large multi-carinated *Squillæ* are so different from the *Lysiosquillæ* that there can be no question as to their distinctness, it is difficult to discover any characteristics which shall separate *Squilla microphthalma* from the latter genus; but we find that this species does not resemble all species of *Lysiosquilla* to an equal degree, for the genus includes species, like *Lysiosquilla* (*Coronis*) *excavatrix* (Pl. X. figs. 8–16), which have, like *Squilla microphthalma*, small eyes and uropods, and flat wide appendages to the exposed thoracic limbs; as well as species which, like *Lysiosquilla maculata*, have these appendages linear and the eyes broad and triangular. We may therefore state with confidence that *Lysiosquilla maculata* and *Squilla nepa* are more divergent than *Lysiosquilla excavatrix* and *Squilla microphthalma*, and that the two genera are divergent branches from a common type, from which both genera have inherited the flat hind body and the many-spined raptorial claw; and that this ancestral form had small eyes, antennary scales and uropods, and a transverse telson.

This ancestral form must have been very similar to two closely related living species, *Squilla bradyi*, Milne-Edwards, and *Gonodactylus trachurus*, Miers, which are referred by Miers to the genus *Gonodactylus* on account of the enlargement of the base of the dactyle, and to *Squilla* by Milne-Edwards on account of the presence on the same organ of marginal spines, and the flatness of the hind body. Their points of resemblance to *Gonodactylus* are also points of resemblance to *Protosquilla*, and as they differ from all the species of *Gonodactylus* in the flatness of the hind body, and the presence of spines on the dactyle, there can be no doubt of the propriety of placing them in a distinct genus, for which I propose the name *Coronida*. *Coronida* has, like the convergent species of *Lysiosquilla* and *Squilla*, small eyes, antennary scales and uropods, a flat hind body, an armed dactyle, and a wide rounded telson, and there can therefore be no doubt of its close relationship to the ancestral type of these genera.

The species of *Coronida*, *Pseudosquilla* and *Gonodactylus*, are closely related, but not in such a way as to indicate that any one genus is the ancestor of the others. The two latter resemble each other, and differ from the first, in the fact that the hind body is convex and narrow and bent downwards at the tip, while it is straight and flat and wide in *Coronida*.

Gonodactylus and *Coronida* resemble each other and differ from *Pseudosquilla* in the presence of an enlargement at the base of the dactyle of the raptorial claw, while *Pseudosquilla* and *Coronida* resemble each other and differ from *Gonodactylus* in the presence of marginal spines on the dactyle.

This triangular relationship can be accounted for only on the hypothesis that they are the divergent descendants of an ancestral form which each one of them resembles in certain features, to which, in each genus, secondary differences have been added.

As there is no reason to suppose that this divergence is recent, we should not expect to find this ancestral form still represented by living species, but as the living species of *Protosquilla* exhibit, like this hypothetical stem form, features of resemblance to each of these genera, it is not only probable, but almost certain, that they are much more directly descended from the ancestral form than any of the species of *Gonodactylus* or *Pseudosquilla* or *Coronida;* and, of course, than any of the *Lysiosquillæ* or *Squillæ*.

Protosquilla resembles *Gonodactylus* in the small size and flatness of its carapace, in the presence of an acute spine on the rostrum, in the unarmed dactyle dilated at its base, in the height of the narrow hind body, the terminal somites of which are bent downwards, and also in the small size of most of the species.

It also resembles *Pseudosquilla* in most of these features, but the dactyle of *Pseudosquilla* is without the basal enlargement, and is usually armed, like that of *Coronida* and the *Squillæ* and *Lysiosquillæ*.

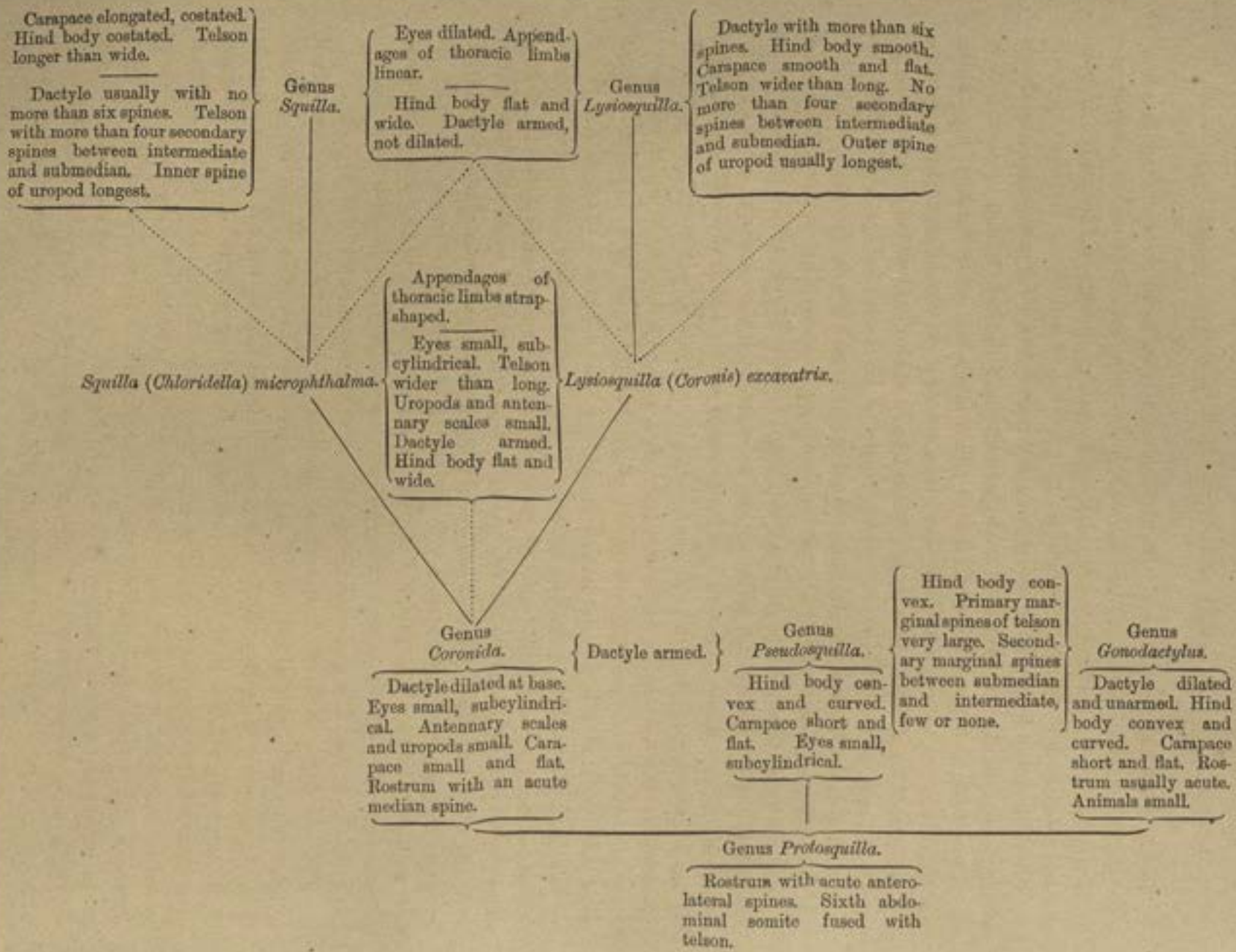
Coronida resembles *Protosquilla* in the small size of its eyes, antennary scales and uropods, the flatness of the small carapace, the enlargement of the base of the dactyle,

and the presence of a median spine on the rostrum, while *Protosquilla* differs from all other Stomatopoda in the length of the acute median spine of its rostrum, and in the presence of acute long spines on its antero-lateral angles, and the union of the sixth abdominal somite with the telson; and as it also exhibits, in its long rostrum, rudimentary uropods, and in the absence of a distinct sixth abdominal somite, a closer resemblance than any other adult to the Stomatopod larva, there can, I think, be no doubt that it is the most primitive genus in the order.

I have attempted to give a graphic representation, in the following diagram, of the relationships between the genera of adult Stomatopoda, the heavy lines indicating their convergent relationship to each other and to *Protosquilla*. The characteristics which are joined by brackets to two or more genera are the features of resemblance between those genera, while those characteristics which are thus joined to only one genus are confined to this genus.

The diagram is intended to express the relationship between the genera as established by the comparative study of all the species; and as it often happens that a feature which is highly characteristic of a genus as a whole may be absent or modified in a few exceptional species, the diagram cannot be used as a means of diagnosis. For example, the *Lysiosquillæ* have, as a rule, the outer one of the two spines on the ventral prolongation from the posterior edge of the basal joint of the uropod longer than the inner, and I have therefore given this feature as characteristic of the genus; for the study of the larvæ shows that it is very significant, although it happens that there are one or two species in which the inner spine is the longest.

While I trust that the diagram is quite intelligible, a word of explanation may be desirable; thus, the genus *Coronida* is shown, by the brackets, to share with *Chloridella*, *Coronis*, and *Protosquilla*, its small eyes, uropods, and antennary scales; with *Chloridella*, *Coronis*, and *Pseudosquilla* the armed dactyle; and with *Protosquilla* the small flat carapace and acute rostral spine.


Carapace elongated, costated. Hind body costated. Telson longer than wide.
Dactyle usually with no more than six spines. Telson with more than four secondary spines between intermediate and submedian. Inner spine of uropod longest.
Genus Squilla.
Eyes dilated. Appendages of thoracic limbs linear.
Hind body flat and wide. Dactyle armed, not dilated.
Genus Lysiosquilla.
Dactyle with more than six spines. Hind body smooth. Carapace smooth and flat. Telson wider than long. No more than four secondary spines between intermediate and submedian. Outer spine of uropod usually longest.
Squilla (Chloridella) microphthalma.
Appendages of thoracic limbs strap-shaped.
Eyes small, subcylindrical. Telson wider than long. Uropods and antennary scales small. Dactyle armed. Hind body flat and wide.
Lysiosquilla (Coronis) excavatrix.
Genus Coronida.
Dactyle armed.
Dactyle dilated at base. Eyes small, subcylindrical. Antennary scales and uropods small. Carapace small and flat. Rostrum with an acute median spine.
Genus Pseudosquilla.
Hind body convex and curved. Carapace short and flat. Eyes small, subcylindrical.
Hind body convex. Primary marginal spines of telson very large. Secondary marginal spines between submedian and intermediate, few or none.
Genus Gonodactylus.
Dactyle dilated and unarmed. Hind body convex and curved. Carapace short and flat. Rostrum usually acute. Animals small.
Genus Protosquilla.
Rostrum with acute anterolateral spines. Sixth abdominal somite fused with telson.

The Accessory Copulatory Organs of the Male Stomatopod.

Before I end the discussion of the phylogenetic relationship between the genera of adult Stomatopoda, I wish to call attention to the importance of figures and descriptions of the complicated structure on the first abdominal appendage of the male. If each description of a new species contained a figure of this structure, the tracing out of the genetic relationship between the species would be greatly simplified; although a knowledge of this organ would, of course, be of no help in our present undertaking, the discovery of the connections between the pelagic larvæ and the adults. Unfortunately the Malacologists have given little attention to this structure, as it cannot be studied to advantage without removing it from the body and mounting it as a microscopic object.

In the case of the Challenger specimens Mr. G. B. Haldeman has kindly done this for me, and has also made the drawings of this organ which are here given.

The endopodite of the first abdominal appendage of the male Stomatopod is furnished, on its inner edge near the tip, with a complicated grasping organ which probably serves for seizing the female, like the grasping forceps of many of the lower Crustacea and some few of the Malacostraca, although I am acquainted with no observations as to their use in the Stomatopoda. The structure has been figured by several observers, but no careful comparative description has ever been published, although it often presents characteristics of specific value, and differs conspicuously in the different genera. One of the most interesting and valuable peculiarities of the organ is that it seems to illustrate the degree of relationship between the various genera, and an exhaustive study of its modifications in the different species will be a very great aid in tracing the phylogeny and genetic relationship of the various genera and species. Unfortunately, several of the new species in the Challenger collections are represented only by female specimens, and the material is too scanty to afford an opportunity for the exhaustive study of the subject, but I am able to give, with the descriptions of several of the new species, figures and descriptions of this structure, and I hope that these descriptions will serve to incite in some one who has access to larger collections a desire to make a more thorough study of it.

The endopodite of the first abdominal appendage of the male Stomatopod consists of a large flat basal joint (Pl. I. fig. 2, A) separated by a movable transverse suture *c* from the terminal joint B, which is notched or bilobed at the tip, and thus completely or incompletely divided into an external leaflet *a*, and an internal one *b*. The latter carries on the anterior surface of its inner edge, at the line of articulation with the proximal joint, the petasma, or forceps, which consists of three portions: (1) the retinaculum or appendix interna *d*, which is rounded at its proximal end, prolonged into a long acute or subacute point distally, and with a straight internal edge which is closely set with several crowded rows of hooked spines which interlace on the middle line with those of the corresponding appendage on the opposite side of the body; (2) the

movable limb *f* of the forceps, which is furnished with a large muscle which runs up into its hollow base, while its tip is spoon-shaped on its external surface which is opposed to the third portion, the fixed limb, *e*, of the forceps. This is a raised ridge on the flat surface of the appendage, with its tip free, and, in most cases, bent into a hook, which is curved towards the spoon-like hollow at the tip of the movable limb.

In *Gonodactylus* (Pl. XV. fig. 4) the terminal joint A is divided into two lobes, *a* and *b*, by a marginal notch, but the inner lobe is not separated from the outer one by a suture. *Pseudosquilla* has justly been regarded, by nearly all writers on the Stomatopoda, as very closely related to *Gonodactylus*, and the modified appendage (Pl. XV. fig. 10) is very similar indeed to that of the latter genus, as will be seen by comparing the figure with that of *Gonodactylus graphurus* (Pl. XV. fig. 8). In both, the inner lobe of the terminal joint is larger than the outer one, and separated from it by a marginal notch but not by a suture.

The close relationship between *Squilla* and *Chloridella* is unquestioned, and I have shown that the species which have been divided between the two genera really form a single phylum or stem which cannot be divided into two genera. A comparison of the modified abdominal appendage of the male *Squilla leptosquilla* (Pl. I. fig. 2), or that of *Squilla quinquedentata* (Pl. II. fig. 6), with that of *Squilla* (*Chloridella*) *chlorida*, will show that there is the closest resemblance. In all these the outer lobe *a* of the terminal joint is separated by a suture from the inner lobe, the tip of which is elongated considerably in advance of the tip of the outer lobe, although the more primitive rank of *Squilla chlorida* is shown by the fact that the separation between the two lobes is much less pronounced than it is in the more typical and highly modified *Squilla*. I have shown that the species of *Lysiosquilla* and *Coronis* also form a single phylum, which it is not practicable to divide into two genera, and the character of the modified appendage is as similar in *Lysiosquilla maculata* (Pl. X. fig. 6) and *Lysiosquilla* (*Coronis*) *excavatrix* (Pl. X. fig. 12) as it is different from that of *Gonodactylus* and *Squilla*. The terminal joint B is subtriangular, and the suture *c* which separates it from the proximal joint is transverse, while it is oblique in the other forms. The outer lobe *a* is very much larger than the inner *b* and triangular, while the inner lobe is very small and nearly circular, and separated by a movable suture from the outer. The movable limb of the forceps *f* is greatly elongated and is not bent at the tip, while the fixed limb *e* is very small and rounded at the tip.

While no classification can ever be accepted as final, the one which I have expressed in the preceding diagram is at least an approximation to the truth, and gives, so far as our present knowledge enables us to trace it, the genealogy of the species of Stomatopoda, so far as this can be established from the study of the adults.

In most animals we look to the larvæ or embryos for evidence of genetic relationship, more satisfactory and intelligible than any which is furnished by the adults, for it is a

general rule, in the animal kingdom, that the larvæ or young of related species are less divergent than the mature animals. Even if we were able to rear the larvæ of the Stomatopods, and thus to use the evidence which they supply, this rule would not apply in this case. The larval life is so long, and forms such a considerable part of the total life of each individual, and the larvæ are so perfectly developed, and their relations to their environment so complex, that there are about as many species of larva as of adults, and the specific differences between them are fully as pronounced; while the differences between different genera of larvæ are often greater than those between the genera of adults. The fully grown larvæ are in no sense embryonic or generalised; they have no reproductive organs, but in all other particulars they are just as highly organised as the mature animals, and if the animals were to become sexually mature while retaining the organisation which fits them for their pelagic life, and if the final sedentary stage were then dropped, we should then have an order of pelagic Crustacea of as high organisation, and with as many well-defined genera and species, as the order Stomatopoda.

The larvæ may thus be treated exactly as if they were adults, and a natural or phylogenetic classification of them established by the comparative study of their organisation exactly as we have done for the adults.

As each larva is only an immature adult, or each adult only a fully grown larva, the genetic history of each specific adult must be identical with that of some specific larva, namely, its own larva.

If, then, comparative anatomy enables us to trace from the study of the adults of an order or family or genus, their natural or genealogical classification, it must of course be possible to do the same thing with the larvæ, and if the classification which is established is natural, there must be a discoverable relation between the one derived from the larvæ and the one derived from the adults.

In most cases this is unnecessary, as we are able to trace the young to its adult form, and to use the whole life history as a basis for classification, and in most cases it would also be extremely difficult, on account of the embryonic or generalized character of young animals, and the absence of conspicuous specific differences, but it fortunately happens that in the Stomatopoda, where we are compelled to resort to this or some other indirect method for discovering what larva pertains to what adult, it is also much more easy than usual, owing to the high specialisation and great diversity of the larvæ.

We cannot expect absolute agreement between the two classifications, for the sources of our evidence can never be complete. We knew nothing of the larval types which may have existed in the past, and next to nothing of the fossil adults, and it is very probable that some of the larvæ belong to unknown adults, and also that the larvæ of some of the known adults are as yet undiscovered, and it is very probable that two allied adults may have remained alike, while their larvæ have been modified in two divergent directions,

and that two allied species of adults may have originated in the same manner from a common type, while their larvæ have remained alike.

Still, after all these allowances, it still remains true that, inasmuch as the larvæ of two closely related species are themselves more closely related by blood than the larvæ of more widely separated species, their bodily structure must exhibit a record of this relationship which can be discovered by study and comparison, and which will agree to some extent with the record presented by the organisation of the adults; the degree of agreement depending upon the completeness of the two records and the correctness of our interpretation.

What then is the natural or phylogenetic classification of the Erichthidæ or Stomatopod larvæ when they are studied by themselves and treated as adult animals?

The genera of Erichthidæ which have been recognised by the systematists are *Erichthoidina*, *Erichthus*, *Squillerichthus*, and *Alima*, and of these four the first, *Erichthoidina*, is simply a young *Erichthus*, and the third, *Squillerichthus*, a fully grown larva of the *Erichthus* type, so that the genera become reduced to two, *Erichthus* and *Alima*. Of these two genera, one, *Alima*, is much more sharply defined than the other, *Erichthus*, which contains a number of divergent types which admit of definition. Three of these types are represented in the collection by numerous species, and are well known. As it will be convenient to have names for them I shall use names which indicate the adult genera or subgenera to which they are to be referred.

The *Gonerichthus* type, which Claus correctly refers to the genus *Gonodactylus*,[1] for reasons which receive added weight from the study of the Challenger specimens, is shown in Pl. XV. fig. 6.

The *Pseuderichthus* type, which Claus has given very conclusive reasons[2] for regarding as the young of *Pseudosquilla*, is shown in Pl. XII. fig. 6.

The *Lysioerichthus* (Pl. XI. figs. 1–5), which Claus erroneously regards as the young of *Squilla*,[3] is, as I shall show, the young of *Lysiosquilla*. These three groups, together with *Alima* (Pl. I. figs. 4, 5), which Claus regards as the young of *Lysiosquilla*,[4] but which, as I shall show, is confined to the genus *Squilla* and diagnostic of this genus, include nearly all the Stomatopod larvæ, although there are a few larvæ which have a more isolated position, such as the one shown in Claus's fig. 14, which I shall designate as *Erichthalima*, and others which are intermediate between the three *Erichthus* types. The statement on p. 610 and footnote in Claus's Grundzüge der Zoologie, that he has shown from the study of alcoholic specimens that *Alima* is the young of *Squilla* will seem to conflict with my own statement that he regards *Alima* as a young *Lysiosquilla*, but a reference to pp. 132, 133, 134, 135, 136, 138, and 154 of his Monograph will show that he refers a number of *Erichthus* larvæ to the genus *Squilla*,

[1] Metamorphose der Squilliden, pp. 138 and 139.
[2] Metamorphose der Squilliden, pp. 140–146.
[3] Metamorphose der Squilliden, pp. 132, 133, 134, 135, 136, and 138.
[4] Metamorphose der Squilliden, p. 154.

and he gives at length, on p. 154, his reasons for regarding *Alima* as the young of *Lysiosquilla*. It is true that he regards *Lysiosquilla* as a branch from the *Squilla* stem, and that in this sense he does hold that *Alima* is a *Squilla* larva, but I suppose no one would now regard *Lysiosquilla* as a *Squilla*.

A comparison of these larvæ with each other indicates that they are all derived from a primitive larval type which was hatched from the egg as an *Erichthoidina*, and reached its final form by gradual growth, and an increase in the number of somites and appendages, without any sudden change or the retrograde development of any of its appendages. It was furnished with a deep carapace, which, however, was not folded inwards at its ventral edges, and it was probably armed with a number of secondary spines between the submedian and intermediate spines of the telson, and the edge of the carapace was probably serrated. The most primitive among the recent adult Stomatopoda might be expected to retain the most primitive larval type. We know of no fully grown larva which can safely be referred to the genus *Protosquilla*, but the primitive larva must have been very similar to what we should have if the *Erichthoidina* shown in figs. 1 and 2 of Pl. XII. were to grow up and acquire its full number of somites and appendages, while the carapace and telson remained without change. The *Gonerichthus* larva (Pl. XV. figs. 1, 3, 6, 11) passes through an *Erichthoidina* stage, its appendages undergo no retrograde metamorphosis, the hind body is convex, the carapace is deep but not folded inwards, there are no secondary spines, or only one or two on the telson between the submedian and the intermediate, the primary spines of the telson are long, and the outer spine of the basal prolongation of the uropod is very much longer than the inner, and no specimens have ever been found with marginal spines on the edge of the long slender dactyle. The last four characteristics are also characteristics of the adult *Gonodactylus*.

In *Pseuderichthus* (Pl. XII. fig. 6) the carapace is deep and very slightly infolded along its lateral edges, the hind body is convex, the dactyle of the raptorial claw of the older larvæ sometimes show traces of marginal spines, the outer spine of the uropod is very much longer than the inner, and the primary marginal spines of the telson are very long, the submedians are tipped with movable spinules, and there are only one or two secondary spines between the submedian and the intermediate. None of these characteristics are absolutely diagnostic of the genus *Pseudosquilla*, but as all except the last are true of the adults of this genus, it is probable that all these larvæ are *Pseudosquillæ*, like the one the history of which has been traced by Claus. If this larva hatches as an *Erichthoidina* it must undergo retrograde metamorphosis, since the younger larvæ have no appendages on the third and fourth or fifth thoracic somites.

In *Erichthalina*[1] the carapace is deep, and its lateral edges are infolded over the ventral surface, and serrated, the hind body is flat, the telson is wider than long, there

[1] Claus, Metamorphose der Squilliden, fig. 14.

are numerous secondary spines on the telson between the submedian and the intermediate, and the dactyle of the raptorial claw is armed with several teeth. In this last respect, and in the flatness of the hind body, it resembles *Squilla* and *Lysiosquilla*, and it also resembles all the *Squillæ*, and differs from all the *Lysiosquillæ* in the great number of secondary spines on the telson, while it resembles the *Lysiosquillæ* and differs from all the *Squillæ* except the most primitive in having the telson wider than long. It resembles the most primitive species of both genera in the small size of its uropods, and Claus's description renders it probable that the adult form to which it gives rise has a long acutely pointed rostrum, thus differing from both *Squilla* and *Lysiosquilla*.

The fact that some of its characteristics are shared by the adults of both these genera, while others are confined to one and still others to the other, while still others are not found in either of them, indicates that its adult may be equally related to but distinct from both of them. Its relation to the *Lysioerichthus* and *Alima* larvæ is of precisely the same character.

The *Lysioerichthus* larva probably passes through an *Erichthoidina* stage, with retrograde metamorphosis of the third, fourth, and fifth thoracic appendages. The carapace is very deep, and in the older larvæ its lateral edges are folded inwards, and they are serrated in the younger larvæ; the dactyle usually bears traces of more than six marginal spines, the hind body is flat and wide, the outer spine of the uropod is nearly always longer than the inner, the telson is wider than long, and there are from one to four spines between the submedian and intermediate, and sometimes a larger number in the very young larva.

There is no evidence that the *Alima* larva ever leaves the egg as an *Erichthoidina*. The third, fourth, and fifth, as well as the three following thoracic appendages, are wanting in the youngest larvæ. The carapace is shallow and flat, and its lateral edges are serrated throughout the whole larval life. The dactyle bears traces of marginal spines which are never more than six in number, the hind body is flat and wide, the telson is longer than wide, except in *Alimerichthus*, and there are numerous secondary spines between the submedian and the intermediate.

In the flatness of the hind body and the presence of spines on the dactyle, *Erichthalmia* resembles both *Lysioerichthus* and *Alima*. It resembles the very young *Lysioerichthus*, and *Alima* at all stages, in the serration of the lateral edges of the carapace, while it resembles all *Lysioerichthi* and differs from all *Alimæ* except *Alimerichthus*, in having the telson wider than long. It resembles all the fully grown *Lysioerichthi* and differs from all *Alimæ* in having the carapace very deep, with its lateral edges infolded, and it differs from all *Lysioerichthi* and resembles all *Alimæ* in having more than four spines between the submedian and intermediate spines of the telson. *Lysioerichthus* has the outer spine of the uropod usually longest, while the

inner is always longest in *Alima*. In *Erichthalima* they are equal, and both very short, as is also the case in some of the more primitive *Lysiosquillæ*, and in *Protosquilla*.

It will thus be seen that *Erichthalima* has certain characteristics which are found nowhere else except in *Alima* or *Squilla*, and others which are found nowhere else except in *Lysioerichthus* or *Lysiosquilla*, and others which are common to both, and others which are found in neither. We must therefore regard it as a more primitive larva than either, equally related to both.

In the *Lysioerichthus* series we have forms which, like *Alima*, have the rostrum and postero-lateral spines long, and others which have them short. And in the *Alima* series we have *Alimerichthus* which has its carapace deep and its telson wider than long, as in *Lysioerichthus*, while the carapace is flat and the telson longer than wide in all the other *Alimæ*.

The relationship between these various larvæ may then be expressed in a diagram as follows :—

Alima. *Lysioerichthus* with short spines.

Alimerichthus. *Lysioerichthus* with long spines.

Erichthalima. *Pseuderichthus*. *Gonerichthus*.

Unknown *Erichthoidina*-like larva.

This classification exactly matches the one given for the adult Stomatopoda on page 12, and, added to the fact that the few larvæ which have been traced to their

adult Stomatopods fall into their proper places, it furnishes very satisfactory proof of the relationship between the larvæ and their adults.

Faxon has reared a *Squilla empusa* from an *Alima* larva. The Challenger collections show that the larva of *Lysiosquilla maculata* is one of the short-spined *Lysioerichthi*; I have reared *Lysiosquilla* (*Coronis*) *excavatrix*, one of the more primitive *Lysiosquillæ*, from a long-spined *Lysioerichthus*. Claus has figured a series which shows beyond question that at least one species of *Pseuderichthus* becomes a *Pseudosquilla*, and the Challenger collections furnish equally good proof that the *Chiragra* group of *Gonodactyli* come from *Gonerichthus* larvæ, and I therefore believe that we may very safely assume that all the *Lysioerichthus* larvæ are young *Lysiosquillæ*, all the *Alima* larvæ young *Squillæ*, *Alimerichthus* one of the lower *Squillæ* or *Chloridellæ*, all the *Gonerichthi* young *Gonodactyli*, *Erichthalima* very probably a young *Coronida*, and all the *Pseuderichthi* very probably young *Pseudosquillæ*. The evidence for this conclusion can be much better estimated after the examination of the special descriptions which follow.

LIST OF SPECIES IN THE COLLECTION.

The small collection of adult Stomatopoda consists of the following fifteen species, of which eight are new, while two of the others, *Squilla fasciata* and *Protosquilla* (*Gonodactylus*) *guerinii*, have been only imperfectly described from single specimens.

As there are few adults which have been traced to their larvæ, and as I am able to give, from the study of the living specimens, an account of the metamorphosis of an undescribed species, *Lysiosquilla* (*Coronis*) *excaratrix*, I have added a systematic description of it, with illustrations, and hence the Report contains notes on the following sixteen species:—

Squilla nepa, Latreille. Five males and two females from Pokoska, Japan, taken with the trawl in 5 to 25 fathoms; one male from Kobé, Japan, 8 to 50 fathoms; one female from Reefs at Honolulu; one female taken with the trawl in 15 fathoms, on the coast of Japan, at Station 233B, lat. 34° 18′ N., long. 133° 35′ E.

Squilla quinquedentata, n. sp. One male from 28 fathoms, at Station 188, in the Arafura Sea, lat. 9° 59′ S., long. 139° 42′ E.

Squilla leptosquilla, n. sp. One male taken with the trawl in 115 fathoms in Celebes Sea, near the Philippine Islands, in lat. 12° 28′ N., long. 22° 15′ E.

Squilla chlorida, n. sp. One male specimen from a depth of 15 fathoms at Amboina, Moluccas.

Squilla fasciata, De Haan. One male and one female from 15 fathoms, at Station 233B, in the Inland Sea, Japan, lat. 34° 18′ N., long. 133° 35′ E.

Squilla lata, n. sp. Two males and one female from 49 fathoms in the Arafura Sea, New Guinea, Station 190, lat. 8° 56′ N., long. 136° 5′ E.

Lysiosquilla maculata, Miers. One mature male from Amboina, one half-grown male from Samboangan, and a mature male and female from Samboangan.

Pseudosquilla ciliata, Miers. One male and one female from 2 fathoms at St. Thomas; one male from Reefs at Honolulu.

Gonodactylus chiragra, Latreille. Numerous males and females from St. Thomas; one male from Bermuda; one male from Station 36, lat. 32° 7′ 25″ N., long. 65° 4′ W., near Bermuda; two from Samboangan, and one from Samboangan Reefs.

Gonodactylus chiragra (var. *minutus*). Numerous male and female specimens from near Cape St. Roque.

Gonodactylus (juv.). Perhaps a young *Gonodactylus chiragra*, from Station 208, near Philippine Islands; 18 fathoms.

Gonodactylus graphurus, White. One male and one female from 8 fathoms, at Station 186, near Cape York, in lat. 10° 30′ S., long. 142° 18′ E.

Gonodactylus glabrous, n. sp. One female specimen from the Reefs at Samboangan.

Protosquilla (*Gonodactylus*) *elongata*, n. sp. One female specimen from St. Vincent, Cape Verde Islands.

Protosquilla (*Gonodactylus*) *cerebralis*, n. sp. One specimen from Fiji.

Protosquilla (*Gonodactylus*) *guerinii*, White. One female specimen from Honolulu.

Lysiosquilla (*Coronis*) *excavatrix*, n. sp. From Beaufort, N.C., U.S.A.

DESCRIPTIONS OF GENERA AND SPECIES.

Order STOMATOPODA.

Family SQUILLIDÆ.

Genus *Squilla*, Fabricius.

Diagnosis.—Stomatopoda with the sixth abdominal somite separated from the telson by a movable joint; the hind body depressed and wide; the dactyle of the raptorial claw without a basal enlargement, but with a series of spines, which are not usually more than six in number, on its inner edge; more than four secondary spines between the intermediate and submedian spines of the telson, which is usually longer than wide; inner spines of ventral prolongation from basal joint of uropod longer than the outer. Larva an *Alima* with the ocular and antennulary somites not covered by the carapace; the lateral edges of the carapace not reflected, but usually bordered by small spines or serrations; the inner spine of the ventral prolongation from the basal joint of the uropod longer than the outer, and the telson with more than four secondary spines between the intermediate and submedian spines.

Remarks.—I have had an opportunity to study the first abdominal appendage of the male in only a few species of *Squilla*, but this organ has well defined common characteristics in all these species, and we may probably add to the diagnostic characteristics given above, the statement that the inner lobe of the terminal joint of the first abdominal appendage of the adult male is longer than the outer, and separated from it by a suture.

While recognising the very close relationship between the genus *Chlorida* (Eydoux and Souleyet) and the genus *Squilla*, Miers thinks that the former genus is a natural one, which should be retained under the modified name *Chloridella*[1] to include the Stomatopoda which have the dactyle of the raptorial claw armed with marginal teeth and without a basal enlargement; the carapace and hind body without longitudinal carinæ; the eyes dilated in the middle and contracted at the tip; the rostrum short; the carapace small and short, and the appendages of the thoracic limbs strap-shaped,

[1] Miers, On the Squillidæ, p. 13.

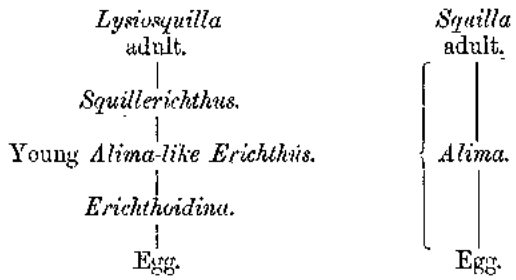
while the genus *Squilla* is restricted by him to those species which, with a similar raptorial claw, have longitudinal carinæ on the carapace and hind body; the eyes not constricted at the tips; the carapace elongated, and the appendages of the thoracic limbs slender and styliform.

The forms which he includes in the genus *Chloridella* are certainly less specialised than the higher *Squillæ*, but the Challenger collections show that they are connected with the latter by intermediate forms in such a way that it is impossible to draw a line between them, and that they do not form two divergent branches, but a single series. *Squilla lata*, n. sp. (Pl. III. figs. 1, 2, 3), is a *Squilla*, according to Miers's definition, while *Squilla chlorida*, n. sp. (Pl. II. figs. 1–5), is a *Chloridella*, but *Squilla fasciata* (Pl. III. figs. 4, 5) is so very similar to both of these species that it is very hard to distinguish from them, and it is intermediate between them in respect to the very characteristics upon which Miers bases his genera. We must therefore enlarge the genus *Squilla* to include the *Chloridellæ*.

Ontogeny.—The *Alima* larva is one of the most sharply defined larval types, and we have every reason to believe that all the larvæ in this group pertain to closely related adults. As one of them has been kept by Faxon in an aquarium until it changed into a young *Squilla*, and as all the species of the genus *Squilla* agree with each other in several features which are not united in any other adult Stomatopod; the flatness of the hind body, the small number of marginal spines on the dactyle, the great number of secondary spines on the telson between the intermediate and the submedian marginal spines, and the greater length of the inner one of the two spines on the basal prolongation of the uropod; and as all the *Alima* larvæ, including *Alimerichthus*, agree with each other, and differ from all other Erichthidæ except the anomalous *Erichthalima*, in similar features, we can state with confidence that all *Alima* larvæ are young *Squillæ*, and that all *Squilla* larvæ are *Alimæ*.

While the *Alima* is a highly specialised larva it is, in a certain sense, embryonic, for the fully grown *Alima* closely resembles the young *Lysioerichthus* larva, as may be seen by comparing fig. 4 of Pl. I. with fig. 5 of Pl. XII. The *Erichthus*, in some cases and probably always, hatches from the egg as an *Erichthoidina*, while it is probable that all the *Alimæ* leave the egg in the *Alima* stage; but this is so similar to the young *Erichthus* that Claus was disposed to regard his *Erichthus multispinosus* as an *Alima*, although the fully grown *Erichthus* is very different from the *Alima* at any stage of its development. Apparently the stage which the *Lysioerichthus* passes through, immediately after the *Erichthoidina* stage, has proved to be so well adapted to the needs of the *Squilla* larva that it has been lengthened at both ends of the larval life until both the initial *Erichthoidina* stage and the final *Squillerichthus* stage have been crowded out of its larval life, and the *Alima* hatches as an *Alima* and remains an *Alima* until it changes into a *Squilla*.

The relation between the metamorphosis of *Lysiosquilla* and that of *Squilla* is therefore something like this—



Squilla nepa, Latreille.

The Challenger collection includes ten specimens of this species: seven of them, five of which are males and two females, from Pokoska, Japan, captured in the trawl in from 5 to 25 fathoms of water; one male specimen from Kobé, Japan, in 8 to 50 fathoms; one female specimen from the Reefs at Honolulu; and one female specimen taken in the trawl at Station 233B, Inland Sea, Japan; May 26, 1875, lat. 34° 18′ N., long. 133° 35′ E.; 15 fathoms; bottom, blue mud.

The tip of the first abdominal appendage of an adult male, *Squilla empusa*, is shown in Pl. II. fig. 7; and that of *Squilla nepa* is almost the same.

Measurements.

No. 1, Large male.	No. 4, Smaller male.
No. 2, Male a little smaller.	No. 5, Large female.
No. 3, Small male.	

Measurements.	In inches and decimals.					In thousandths of total length.				
	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.
Total length from tip of rostrum to tip of telson,	5·48	5·05	4·26	2·56	5·53	...	...	...	...	...
Rostrum,	·14	·14	·13	·09	·14	·026	·028	·031	·35	·026
Carapace,	1·18	1·13	·97	·53	1·17	·215	·223	·228	·207	·219
Carapace including rostrum,	1·32	1·27	1·10	·62	1·31	·241	2·51	·259	·242	·245
From posterior edge of carapace to posterior edge of second thoracic somite,	·20	·16	·13	·10	·20	·056	·032	·031	·040	·037
From posterior edge of second thoracic to posterior edge of third thoracic somite,	·20	·17	·13	·10	·20	·056	·034	·031	·040	·037
From posterior edge of third thoracic to posterior edge of fourth thoracic somite,	·26	·20	·18	·12	·24	·067	·040	·042	·048	·035
From posterior edge of fourth thoracic to posterior edge of fifth thoracic somite,	·26	·20	·18	·12	·24	·067	·039	·042	·048	·035
First abdominal somite,	·43	·37	·27	·20	·45	·078	·073	·065	·079	·085
Second abdominal somite,	·36	·36	·27	·20	·40	·066	·071	·065	·079	·075
Third abdominal somite,	·36	·36	·27	·18	·40	·066	·070	·065	·070	·075
Fourth abdominal somite,	·38	·36	·31	·16	·43	·069	·070	·073	·064	·080
Fifth abdominal somite,	·50	·42	·35	·22	·47	·091	·082	·082	·070	·088
Sixth abdominal somite,	·36	·34	·28	·16	·31	·066	·065	·066	·064	·058
Telson on middle line,	·85	·84	·79	·38	·88	·155	·184	·186	·160	·166
Total length of hind body,	4·16	3·78	3·16	1·94	4·22	·837	·761	·748	·762	·770
Total length on middle line from tip of rostrum to tip of telson,	5·48	5·05	4·26	2·56	5·53	1·078	1·012	1·007	1·004	1·015
Greatest length of telson,	1·08	·96	·92	·46	1·12	·199	·190	·216	·179	·207
Width of carapace at antero-lateral angle,	·62	·57	·52	·28	·64	·113	·114	·122	·109	·120
Width of carapace at postero-lateral angle,	·96	·90	·84	·44	1·00	·175	·180	·197	·172	·187
Width of second thoracic somite,	·92	·82	·76	...	·90	·168	·164	·178	...	·168
Width of third thoracic somite,	·97	·88	·74	...	·96	·177	·176	·174	...	·184
Width of fourth thoracic somite,	·98	·92	·78	·45	1·00	·179	·194	·183	·176	·187
Width of fifth thoracic somite,	·92	·90	·76	...	·92	·168	·180	·178	...	·172
Width of first abdominal somite,	1·12	1·05	·89	·59	1·20	·204	·210	·209	·195	·224
Width of second abdominal somite,	1·20	...	...	...	1·21	·219	...	...	...	·233
Width of third abdominal somite,	1·22	...	...	...	1·24	·223	...	...	...	·233
Width of fourth abdominal somite,	1·24	...	...	...	1·25	·226	...	...	...	·224
Width of fifth abdominal somite,	1·24	1·20	1·02	·59	1·26	·226	·238	·240	·231	·226
Width of sixth abdominal somite,	1·10	1·02	·88	·48	1·11	·201	·202	·207	·187	·208
Width of telson between postero-median spines,	·32	·30	·24	·12	·30	·058	·059	·056	·047	·056
Width of telson between postero-lateral spines,	·83	·88	·80	·30	·90	·151	·174	·188	·117	·168
Width of telson (greatest),	1·10	1·04	·90	·49	1·10	·201	·206	·211	·191	·206
Total length of first antenna,	2·40	2·40	...	...	1·80	·438	·475	...	...	·336
Length of scale of second antenna,	·84	·74	·66	·38	...	·153	·147	·155	·148	...
Length of eye,	·24	...	...	...	·24	·044	...	...	...	·045
Width of eye,	·30	...	...	...	·25	·055	...	...	...	·047

Squilla quinquedentata, n. sp. (Pl. I. fig. 3; Pl. II. fig. 6).

Diagnosis.—Dactylus of raptorial claw with five teeth, including terminal one. Free somites of hind body with submedian dorsal carinæ, which are absolute in the four exposed thoracic and the first four abdominal somites, as are also the next pair in the thoracic and first three abdominal somites. Appendages of exposed thoracic legs slender. Lateral margins of first three exposed thoracic somites bilobed.

General Description.—Rostral plate nearly rectangular, a little longer than wide, with antero-lateral angles rounded, and lateral edges raised into ridges or marginal

carinæ which are continued forwards as far as the rounded angles. Between these marginal ridges the dorsal surface of the rostrum is smooth, without a median carina, with the posterior half pigmented (in the alcoholic specimen) and separated by a semicircular line, convex in front, from the anterior colourless half. Antero-lateral angles of carapace ending in very short acute spines; postero-lateral angles rounded and not prominent, and without a marginal notch. The carapace has a median longitudinal carina which is very slightly raised, although its dark colour renders it conspicuous. It is bifurcated at its anterior end and is interrupted at the transverse cervical suture, behind which it is bifurcated to its posterior end, where the two divisions meet in a round median tubercle on the posterior edge of the carapace. A lateral carina, marked with dark pigment, runs from the antero-lateral spine on each side nearly parallel to and close to the lateral edge of the carapace, as far as the postero-lateral angle, on which it ends abruptly, without uniting with the transverse pigmented ridge which fringes the posterior border of the carapace.

A second pigmented carina runs backwards from the antero-lateral angle for about half the length of the carapace, internal to the submarginal keel, and nearer to it anteriorly than posteriorly. At its posterior end it is about half way between the edge of the carapace and a strongly marked convex ridge which lies in the longitudinal gastric suture, between the elevated convex median gastric area and the lateral area. The gastric sutures and their ridges are slightly divergent posteriorly, and they are interrupted at the transverse cervical suture, behind which the cardiac sutures are marked by similar elevated ridges, which are slightly incurved at their anterior ends, behind which they are slightly convergent posteriorly. External to the cardiac sutures there is, on each side, a short pigmented carina, which fuses with the pigmented border of the posterior edge of the carapace, which latter is slightly emarginated, with a short acute median tooth.

The second, third, and fourth thoracic somites have each a median slightly impressed white line, and on the sides of this a pair of pigmented submedian longitudinal carinæ, which are very short on the second, and which are clearly marked by their dark colour, but are scarcely elevated above the general surface. The fifth thoracic somite has no impressed median line, and the submedian carinæ are like those on the preceding somite. The submarginal carinæ of the thoracic somites are scarcely elevated, and they are marked by dark pigment, as are also the posterior borders of all the thoracic and abdominal somites. The lateral processes of the second, third, and fourth thoracic somites are bilobed; the anterior lobe of the first is elongated, curved forwards and acute, while the posterior lobe is much shorter and subacute. On the lateral process of the third thoracic somite the anterior lobe is shorter and subacute, and on the fourth somite it is still shorter, while in both the third and the fourth somites the posterior lobe is the larger, and its postero-lateral angle is acute on the third, and subacute on the fourth. The fifth thoracic somite has only a single subacute lobe on each side. The first five

abdominal somites have eight keels each, including the marginal ones, and the sixth abdominal somite has six. In all the abdominal somites the postero-lateral angles end acutely in spines, as do the posterior ends of all the keels on the sixth and fifth, and all except the submedians of the fourth. There are no median keels between the carapace and the telson, but the third, fourth, and fifth abdominal somites have median tubercles. The submedian keels of the fifth abdominal somite diverge posteriorly, while all the keels of the sixth abdominal somite converge posteriorly. The first lateral keels of the first, second, and third abdominal somites are slightly sinuous. The telson has a very prominent median dorsal carina, which is situated upon the middle line of an elongated convex protuberance. The carina ends posteriorly in a prominent acute spine, and it is bordered by dark pigment at each end and in the middle. The margin of the telson carries six acute spines, with a short dorsal carina running forwards from the base of each of them, and a similar carina, without a spine, on the anterior portion of the lateral margin. The submedian spines are straight, the intermediate curved, and the externals curved and very short. There is a single rounded lobe or tooth between the base of the external spine and the base of the intermediate spine on each side, and eight on each side between the base of the intermediate spine and the base of the submedian, and six between the submedians, three of them on each side of the deep median notch, which is closed behind and converted into a foramen in the single specimen which was obtained. On each side of the broad median longitudinal ridge the dorsal surface of the telson is marked by shallow pits symmetrically arranged in curved lines, running outwards and backwards from the median ridge to the notches between the rounded lobes on the posterior border of the telson. The ventral prolongation from the basal joint of the uropod ends in a short curved outer branch, and a much stouter and longer inner branch which carries a blunt rounded tooth on its outer edge about half way between the base and the tip, and a number of irregular serrations along its inner edge.

The outer edge of the second joint of the exopodite of the uropod is fringed by a series of seven movable spines, the first six of which increase regularly in size towards the tip, while the seventh is much larger than the sixth, and is terminal. The eye is broadly triangular, and its length from its union with the short stalk to the rounded posterior angle of the cornea is about equal to its width between the two rounded angles of the cornea, which is divided into two halves by a transverse vertical furrow. The ocular somite is exposed on the middle line. The dactylus of the raptorial second maxilliped is divided into five curved acute teeth, and the keel on the anterior edge of the third or carpal joint is smooth and entire.

The movable ramus *f* (Pl. II. fig. 6) of the forceps on the first abdominal appendage of the male is very large, and four times as long as the fixed ramus, which is bent into a single hook at its tip.

Measurements.	In inches and decimals.	In thousandths of total length.
Total length from tip of rostrum to tip of median spine of telson,	5·37	...
Measurements along middle line :—		
Rostrum,	·16	30
Carapace,	1·28	238
Total length of rostrum and carapace,	1·44	268
From posterior edge of carapace to posterior edge of second thoracic somite,	·13	24
From posterior edge of second to posterior edge of third thoracic somite,	·24	45
From posterior edge of third to posterior edge of fourth thoracic somite,	·22	41
From posterior edge of fourth to posterior edge of fifth thoracic somite,	·24	45
First abdominal somite,	·40	74
Second abdominal somite,	·36	67
Third abdominal somite,	·36	67
Fourth abdominal somite,	·40	75
Fifth abdominal somite,	·50	93
Sixth abdominal somite,	·34	63
Telson on middle line,	·74	138
Total length of hind body,	3·93	732
Total length on middle line,	5·37	1000
Greatest length of telson,	·96	179
Width of carapace between antero-lateral spines,	·58	98
Greatest width of carapace,	·94	175
Width of second thoracic somite,	·88	164
Width of third thoracic somite,	·90	168
Width of fourth thoracic somite,	·92	171
Width of fifth thoracic somite,	·92	171
Width of first abdominal somite,	1·08	201
Width of second abdominal somite,	1·16	216
Width of third abdominal somite,	1·16	214
Width of fourth abdominal somite,	1·16	216
Width of fifth abdominal somite,	1·16	216
Width of sixth abdominal somite,	·98	183
Width of telson between postero-median spines,	·22	41
Width of telson between postero-lateral spines,	·82	153
Width of telson (greatest),	1·04	194
Length of first antenna (shaft),	1·00	189
Length of first antenna (flagellum),	·90	168
Length of first antenna (total),	1·90	357
Length of flagellum of second antenna, including shaft,	·96	179
Length of scale of second antenna,	·88	164
Length of eye,	·20	37
Width of eye,	·23	43

Habitat.—Station 188, September 10, 1874, Arafura Sea; lat. 9° 59′ S., long. 139° 42′ E.; depth, 28 fathoms; bottom, green mud. A single male specimen.

Remarks.—Notwithstanding the fact that it has five teeth instead of six on the dactylus of the raptorial claw, and the very slight development of the longitudinal carinæ on the hind body, this species bears such a very close general resemblance to the well known *Squilla nepa*, that I was at first inclined to regard it as a smooth specimen of this species, with an accidental variation in the number of teeth on the dactylus, and the more especially as *Squilla nepa* is known to occur in the region where the specimen was obtained. More careful examination, however, reveals so many minute points of difference in all parts of the body that I think there can be no doubt of its distinctness. The following, which are the most conspicuous differences, will serve to distinguish it with readiness from the latter species. *Squilla nepa* has six and *Squilla quinquedentata* five spines, including the terminal one, on the dactylus of the raptorial claw. The carinæ on the anterior edge of the third joint or carpus of the raptorial claw of *Squilla nepa* is irregularly dentated, while it is entire and smooth in *Squilla quinquedentata*. The rostrum of *Squilla nepa* narrows slightly towards the tip, while that of *Squilla quinquedentata* is more nearly rectangular. The longitudinal cardiac sutures on the posterior portion of the carapace are divergent posteriorly in *Squilla nepa*, and convergent in *Squilla quinquedentata*. The submedian carinæ of the fifth abdominal somite are parallel in *Squilla nepa*, and divergent posteriorly in *Squilla quinquedentata*.

Squilla leptosquilla, n. sp. (Pl. I. figs. 1, 2).

Diagnosis.—Ocular segment in front of rostrum. Eyes broad and sub-triangular. Exposed segments of hind body with submedian carinæ. Dactylus of raptorial claw with four spines, including the terminal one. Antennulary somite very long, reaching to tip of rostrum on middle line, and with its antero-lateral angles prolonged forwards into acute spines. First thoracic somite partially exposed dorsally. Lateral margins of second, third, and fourth thoracic somites acute. Telson with a long slender median spine on dorsal surface, and three pairs of marginal spines, of which the second or intermediate pair are much the longest, and the external pair shorter than the submedians, and blunt, while the others are acute. First antennæ very long.

General Description.—Rostrum nearly twice as long as wide, subtriangular, with a rounded anterior end. Width of carapace between antero-lateral angles about $\frac{9}{14}$ of its greatest width, which is equal to about two-thirds ($\frac{14}{20}$) of its length. The length of the carapace is $\frac{209}{1000}$ of the total length of the body, and its antero-lateral angles are produced forwards as long acute spines, while the postero-lateral angles are prominent and broadly rounded. The gastric area of the carapace is convex and elevated, with an obscure

median carina, which is continued forwards on to the rostrum, and is interrupted behind by the strongly marked cervical sutures, posterior to which the median carina is continued to the posterior edge of the carapace, where there is no median tubercle. There are two longitudinal carinæ on each lateral portion of the carapace, a submarginal one, which lies near the base of the antero-lateral spine, along nearly the whole length of the carapace parallel to and near the thickened lateral margin, and a second or internal one, which lies about midway between the first and the gastric suture, and comes to an end in front of the transverse cervical suture. The thickened ridge which borders the lateral margin of the carapace and the rounded postero-lateral lobe bends inwards around the posterior margin of the latter, and running forwards on the dorsal surface of the carapace, forms a submedian carinæ parallel to and just outside the cardiac suture, and extending forwards as far as the transverse cervical suture. The posterior edge of the carapace, which does not completely cover the first thoracic somite, is nearly transverse.

The second, third, fourth, and fifth thoracic somites have each four longitudinal dorsal carinæ, the submedian on the second being very short and concave towards the middle line; the first five abdominal somites have each six longitudinal carinæ besides the marginal ones, and the sixth somite six in all, which all end posteriorly in acute spines, while there are no spines on the submedians of the thoracic and first five abdominal somites, nor on the first lateral carinæ of the thoracic and first abdominal.

The marginals and submarginals of the first five abdominal somites, and the intermediates of all except the first abdominal, end in spines. The submedian dorsal carinæ are parallel in the first eight exposed somites, divergent posteriorly in the fifth abdominal somite, and convergent posteriorly in the sixth abdominal somite. While the somites increase slightly in width from in front backwards the space included between the second pair of carinæ is of uniform width from the second thoracic to the fifth abdominal somite, and these carinæ form the prominent parallel ridges running along the whole length of the abdomen, although the carina itself is interrupted by a notch near the anterior edge of each abdominal somite except the sixth. The second, third, fourth, and fifth abdominal somites have each a median dorsal double tubercle. The lateral processes of the thoracic somites are much like those of *Squilla mantis*. The lateral margin of the second is prolonged with a long straight acute lobe, while the third and fourth are obliquely truncated, the third more obliquely than the fourth, and end behind in acute points. The fifth is furnished at its antero-lateral angle with a small subacute process or tooth. The telson ends in six marginal spines, of which the submedians are acute and triangular, the intermediates very long, curved, slender, and acute, and about twice as long as the submedians, and the laterals very short, about half the length of the submedians, rounded and subacute. The tips of the long median spines are in the same transverse line with the tips of the submedians, while their bases are in the same transverse line with the base of the unpaired median spine. There is a single rounded dentation between the

base of the lateral spine and the base of the intermediate, and between the base of the intermediate and the tip of the submedian eleven or twelve small acute serrations, while there are about the same number of similar but much smaller serrations between the tip of the submedian spine and the middle line. The dorsal surface of the telson has a median longitudinal ridge which ends behind in a long slender acute spine. On each side of the ridge there is a longitudinal row of five or six shallow circular pits, from each one of which a faintly marked curved line runs outwards and backwards to the posterior margin. The endopodite of the uropod is long, slender, curved, and about eight times as long as wide, and the elongated oval paddle of the exopodite is about equal in length to the second joint. The ventral prolongation from the posterior edge of the basal joint ends in two slender acute curved spines, of which the inner is much (about $\frac{3}{2}$) longer than the outer, with a small tooth on its outer, and a series of minute serrations on its inner edge.

The eyes are broadly subtriangular, and the distance from the rounded posterior angle of the cornea to the point where the eye joins the constricted stalk is equal to the distance between the angles of the cornea, which latter is divided into two nearly equal lobes by a vertical groove. The ocular somite lies entirely in front of the rostrum. The first antenna has a very long slender shaft, and its total length to the tip of the internal or longest flagellum is a little more than half ($\frac{55}{100}$) the total length of the body from the tip of the rostrum to the tip of the telson. The anterior edge of the somite which carries the first antennæ is under the tip of the rostrum, and its antero-lateral angles are produced forwards as slender acute spines. The raptorial second maxilliped is long, and its dactylus has on its inner edge four spines, including the terminal one, which are acute, curved, and gradually increasing in size distally. On the outer edge of the dactylus near the base there is a small process. The three pairs of exposed thoracic legs are short and slender, and their appendages are filiform. The endopodite of the first abdominal appendage of the male (Pl. I. fig. 2) is elongated and nearly rectangular, and the inner edge is straight. The outer lobe *a* of the terminal joint is much shorter than the inner lobe *b*, which is separated from it by a suture. The fixed limb of the petasma *e* is very long, reaching nearly to the tip of the inner lobe, and its tip carries on its inner edge two hooks or lobes, one of which points towards the tip and the other towards the base of the appendage.

Habitat.—The Challenger collection includes only one specimen, a male, from Station 204B, lat. 12° 46′ N., long. 122° 10′ E., in the Celebes Sea, near the Philippine Islands, taken with the trawl from a depth of 115 fathoms; bottom, green mud.

Measurements.	In inches and decimals.	In thousandths of total length.
On middle line :—		
Rostrum,	·10	36
Carapace,	·58	209
Carapace, including rostrum,	·68	245
From posterior edge of carapace to posterior edge of second thoracic somite,	·10	36
From posterior edge of second to posterior edge of third thoracic somite,	·13	47
From posterior edge of third to posterior edge of fourth thoracic somite,	·13	46
From posterior edge of fourth to posterior edge of fifth thoracic somite,	·14	50
First abdominal somite,	·20	72
Second abdominal somite,	·20	72
Third abdominal somite,	·20	72
Fourth abdominal somite,	·18	65
Fifth abdominal somite,	·25	90
Sixth abdominal somite,	·13	43
Telson on middle line,	·34	158
Total length of hind body,	2·00	635
Total length on middle line,	2·68	1000
Greatest length of telson,	·44	158
Width of carapace between antero-lateral angles,	·24	86
Width of carapace (greatest),	·39	140
Width of second thoracic somite,	·41	147
Width of third thoracic somite,	·41	147
Width of fourth thoracic somite,	·41	147
Width of fifth thoracic somite,	·40	144
Width of first abdominal somite,	·52	187
Width of second abdominal somite,	·54	194
Width of third abdominal somite,	·55	198
Width of fourth abdominal somite,	·56	201
Width of fifth abdominal somite,	·56	201
Width of sixth abdominal somite,	...	...
Width of telson between submedian terminal spines,	·13	46
Width of telson between intermediate terminal spines,	·37	133
Width of eyes between angles of cornea,	·13	46
Length of eyes,	·13	46
Length of basal joint of first antenna,	·22	79
Length of second joint of first antenna,	·26	94
Length of third joint of first antenna,	·23	83
Length of flagellum of first antenna,	·75	296
Length of flagellum of second antenna,	·61	222
Length of scale of second antenna,	·50	180
Length of somite of first antenna,	·14	50
Length of labrum,	·36	129

Remarks.—This species differs from *Squilla miles*, Hess., in the presence of acute spines on the antero-lateral angles of the carapace, and in the absence of triangular

processes on the four somites of the hind body, and of movable spinules on the submedian spines of the telson. It differs from Mier's genus *Leptosquilla* in the enlargement of the tips of the eyes, and in the presence of distinct submedian carinæ on all the five somites of the hind body.

Squilla lata, n. sp. (Pl. III. figs. 1, 2, 3).

Diagnosis.—The dactylus of the raptorial limb has six teeth, and the pectinations on the inner edge of the second joint are arranged in an undulating line. Eyes directed forward, nearly cylindrical, with corneal portion hardly wider than base. Appendages of exposed thoracic limbs strap-shaped. Hind body gradually increasing in width backwards to the fifth abdominal somite, which is equal in breadth to one-fourth of the total length. Inner spine of basal joint of sixth abdominal appendage with a rounded tooth on its outer edge, and, on its inner edge, a series of acute dentations gradually increasing in length distally. Rostrum elongated, nearly twice as long as wide. Submedian dorsal carinæ absent on the first and second thoracic and second and third abdominal somites, and obsolete on all the others except the sixth abdominal, where they are well developed. Submedian spines of telson curved at their tips; and flattened, broad and rounded at their bases, with no intermediate dentations. Dorsal surface of telson obscurely marked by curved lines. Paddle of exopodite of sixth abdominal appendage as long as second joint. There is no spine on the dorsal surface of the basal joint of the sixth abdominal appendage. Lateral edges of second thoracic somite acute, those of the third and fourth obliquely truncated.

Special Description.—Rostrum twice as long as broad, and ending in a rounded point. Antero-lateral angles of carapace acute, posterior angles rounded, anterior border subacute, posterior border nearly transverse. No median carina on rostrum or carapace, the gastric area of which is only slightly convex. On each side of carapace there is a carina which reaches nearly to the cervical suture, behind which there is a short carina on each postero-lateral lobe. A median dorsal tubercle close to the posterior edge of the carapace. Length of rostrum $\frac{47}{1000}$, and of carapace $\frac{205}{1000}$, and of the two $\frac{252}{1000}$ of the total length. Hind body gradually and uniformly increasing in width from in front backwards to the fifth abdominal somite, which is more than twice $(\frac{251}{166})$ as wide as the second thoracic somite. The second thoracic somite has no dorsal carinæ; the third has one lateral carina on each side, but no submedians; the fourth and fifth thoracic somites have very obscure and short median carinæ which converge anteriorly, as well as lateral carinæ. The first five abdominal somites have three lateral carinæ on each side. The first three have no submedian carinæ, while there are short obsolete submedian carinæ on the fourth and fifth, converging anteriorly. The third, fourth, and fifth abdominal somites have each a median dorsal tubercle. The sixth abdominal somite has two well marked sub-

medians and two pairs of lateral ones, all six ending in spines, while none of the other carinæ end in spines. The telson has a broad convex median dorsal ridge which ends behind in a short acute spine, and on each lateral portion there are six obsolete symmetrical curved lines. The posterior border of the telson carries six lobes or teeth, the laterals and postero-laterals acute and straight, while the acute points of the submedians are curved inwards. There is a single rounded lobe between the lateral and the postero-lateral, six between the postero-lateral and postero-median, and none between the postero-medians, the space being filled up by the flattened bases of the spines which meet on the middle line. The sixth abdominal appendage is very large, and the terminal paddle of the exopodite is oval and equal in length to the proximal joint. The endopodite is long, curved, and narrow, and the prolongation from the lower surface of the basal joint ends in a short curved acute outer spine, and a much longer inner spine, which has a rounded tooth on its outer border and on its inner border six or seven acute teeth which increase in size distally. There is no dorsal spine on the basal joint.

The ocular segment is wholly anterior to the long rostrum, and the eyes are directed forwards side by side, and are twice as long as wide and swollen in the middle, although the retinal portion, which is divided by a depression into halves, is a little wider than the base. The first antennæ are short ($\frac{29}{100}$ of the total length) and their somite ends dorsally in a pair of lateral spines which point forward. The flagellum of the second antenna, including the three-jointed shaft, is nearly ($\frac{23}{28}$) as long as the first, and the scale is $\frac{11}{100}$ as long as the animal.

The width of the carapace between the antero-lateral spines is about half ($\frac{10}{18}$) its greatest width, and almost exactly half its length. The dactylus of the raptorial claw of the second maxilliped is armed with six curved acute teeth, gradually increasing in size distally. The second joint has three movable spines on its inner edge, and the pectinations of its outer edge are arranged in an undulating line, with a convexity under each tooth of the dactylus (see fig. 2 Pl. III.). The appendages of the three pairs of exposed thoracic legs are flat, strap-shaped, and dilated at the tips. The lateral edges of the second thoracic somite are acute and a little curved forward, and those of the third and fourth somites are obliquely truncated, with subacute anterior and posterior angles. The fifth has no angular process. Sexes alike.

Habitat.—Station 190, in the Arafura Sea, south of New Guinea, September 12, 1874; lat. 8° 56′ S., long. 136° 5′ E.; 49 fathoms; two males and one female taken in the trawl.

Remarks.—This and the following species, *Squilla fasciata*, closely resemble the genus *Chloridella* in the shape of the eyes, and in the flattened strap-like form of the appendages to the exposed thoracic limbs. They agree in many points, as will be shown in the description of the second species, but there are so many well-marked differences that there can be no doubt of their distinctness.

Measurements.	In inches and decimals.	In thousandths of total length.
Total length from tips of eyes to tips of spines of telson,	3·500	
On middle line :—		
From tip of rostrum to tip of telson,	3·225	1000
Rostrum,	·150	47
Carapace,	·660	205
Carapace, including rostrum,	·810	252
From posterior edge of carapace to posterior edge of second thoracic somite,	·070	22
From posterior edge of second to posterior edge of third thoracic somite,	·145	45
From posterior edge of third to posterior edge of fourth thoracic somite,	·125	39
From posterior edge of fourth to posterior edge of fifth thoracic somite,	·145	45
First abdominal somite,	·255	79
Second abdominal somite,	·215	67
Third abdominal somite,	·220	68
Fourth abdominal somite,	·220	68
Fifth abdominal somite,	·280	87
Sixth abdominal somite,	·230	71
Telson on middle line,	·510	158
Length of free somites,	2·415	749
Total length on middle line,	3·225	1000
Length of telson to tips of spines,	·620	192
Width of carapace between antero-lateral spines,	·340	105
Width of carapace (greatest),	·585	181
Width of second thoracic somite,	·495	153
Width of third thoracic somite,	·535	166
Width of fourth thoracic somite,	·595	184
Width of fifth thoracic somite,	·585	181
Width of first abdominal somite,	·740	229
Width of second abdominal somite,	·780	242
Width of third abdominal somite,	·805	250
Width of fourth abdominal somite,	·810	251
Width of fifth abdominal somite,	·810	251
Width of sixth abdominal somite,	·690	217
Width of telson between postero-median spines,	·130	40
Width of telson between postero-lateral spines,	·470	146
Width of telson (greatest),	·635	197
Total length of sixth abdominal appendage,	·426	132
Distance between tips of abdominal appendages,	1·600	496
Length of paddle of exopodite of sixth abdominal appendage,	·265	82
Length of base of exopodite of sixth abdominal appendage,	·265	82
Length of endopodite of sixth abdominal appendage,	·408	126
Length of eye,	·135	42
Width of eye,	·095	29
Length of first antenna, measured from tip of rostrum,	·925	287
Length of flagellum of second antenna,	·770	239
Length of scale of second antenna,	·360	112
Distance from tip of rostrum to cervical suture, on *middle line*,	·675	209

In its general characteristics this species conforms pretty exactly to Mier's description of *Squilla dubia* of Milne-Edwards (*Squilla rubrolineata*, Dana and v. Martens), but it may readily be distinguished from this species, which is recorded only from the western shore of the Atlantic, by the absence of submedian carinæ on most of the free somites, and by the absence of dentations between the submedian spines of the telson.

Squilla fasciata, De Haan (Pl. III. figs. 4, 5 ; Pl. II. fig. 8).

Squilla fasciata, De Haan, Fauna Japon., Crustacea, p. 224, p. 2, 2*i*, fig. 4, 1849.
Squilla fasciata, Miers, Squillidæ, Ann. and Mag. Nat. Hist., ser. 5, vol. v. p. 29, 1880.

Diagnosis.—Six teeth on dactylus of raptorial claw. Dentations on inner edge undulating. Eyes directed forward, nearly cylindrical, with conical portion hardly wider than the base. Appendages of exposed thoracic limbs strap-shaped. Hind body gradually increasing in width from in front backwards to the fifth abdominal somite, which is equal in breadth to more than one-fourth of the total length. Inner spine of basal joint of sixth abdominal appendage longer than outer, with a rounded tooth on its outer and on its inner edge a series of acute dentations gradually increasing in length distally. Rostrum only a little longer than wide. Submedian dorsal carinæ entirely absent in all the exposed somites of the hind body except the sixth abdominal. Submedian spines of telson acute, with about eight intermediate acute dentations. Dorsal surface of telson with four or five sharply defined longitudinal carinæ on each side of the median ridge. Paddle of exopodite of sixth abdominal appendage about half as long as second joint, and an acute spine on the dorsal surface of the basal joint of the appendage. Lateral edges of second thoracic somite acute, those of the third and fourth rounded.

Special Description.—Rostrum only a little longer than wide, subtriangular, with a broadly rounded tip. Antero-lateral angles of carapace acute; postero-lateral angles rounded; anterior border nearly transverse; posterior border deeply notched on middle line. No median carina on the rostrum or on the carapace, the gastric area of which is conspicuously convex. Lateral carinæ of carapace very faintly indicated. No median dorsal tubercle on posterior edge of carapace. Length of rostrum $\frac{42}{1000}$, and of the carapace $\frac{231}{1000}$, and of the two $\frac{378}{1000}$ of the total length. Hind body gradually and uniformly increasing in width from in front backwards to the fifth abdominal somite, which is one and one-half times as broad as the second thoracic somite. There are no submedian dorsal carinæ on any of the exposed somites of the hind body except the sixth abdominal; the second thoracic somite has no dorsal carinæ. The third, fourth, and fifth have each a pair of lateral carinæ, and the first five abdominal somites have each three pairs of lateral carinæ, including the marginal ones; all of which, except the inner ones of the first abdominal somite, end in spines. The sixth abdominal somite has well-marked submedian carinæ converging posteriorly, and two pairs of lateral ones, all six

ending in spines. The telson has a broad convex median dorsal ridge which ends behind in a short acute spine, and on each lateral portion there are four or five sharply defined parallel longitudinal carinæ. The posterior border of the telson has three pairs of acute straight spines, and there is a single rounded tooth between the lateral and postero-lateral, eight acute curved teeth between the latter and the submedian, and four between this and the middle line, which is deeply notched. The sixth abdominal appendage is very large, and the terminal paddle of the exopodite is oval and half as long as the proximal joint. The endopodite is long, narrow, and very slightly curved, and the prolongation from the ventral surface of the basal joint ends in a short curved acute outer spine, and a much longer acute inner spine which has a rounded tooth on its outer border, and on its inner border seven or eight acute teeth which increase in size distally. There is an acute spine on the dorsal surface of the basal joint.

The rostrum reaches to the base of the ocular segment, and the eyes are directed forward, side by side, and nearly cylindrical and about twice as long as wide. The first antennæ are long ($\frac{4}{10}$ of the total length of the body), and their somite ends dorsally in a pair of acute spines which are slightly divergent. The flagellum of the second antenna, including the shaft, is about three-fourths ($\frac{23}{40}$) as long as the first, and the scale is $\frac{17}{100}$ as long as the animal. The width of the carapace between the antero-lateral angles is half ($\frac{19}{20}$) its greatest width and a little less than half ($\frac{19}{23}$) its length. The dactyle of the raptorial claw is armed with six acute curved teeth gradually increasing in size distally. The second joint has three movable spines on its inner edge, and the pectinations on its inner edge are arranged in an undulating line, with a convexity under each tooth. The appendages of the three pairs of exposed thoracic limbs are flat, strap-shaped and more dilated and rounded at the tip than they are in *Squilla lata*. The lateral edges of the second thoracic somite are acute, and strongly curved forward, while the lateral edges of the third and fourth are rounded. The fifth has a subacute prominence on each side. Males and females alike, except as regards the structures concerned in reproduction.

Habitat.—Station 233B, Inland Sea, Japan, May 26, 1875; lat. 34° 18′ N., long. 133° 35′ E.; depth 15 fathoms; bottom blue mud.

Two specimens, a male and a female, were obtained. The only other specimen known is also from Japan, and is described by De Haan as the type of the species.

Remarks.—This species is very similar to the one last described, agreeing with it in the presence of six teeth in the raptorial claw, the cylindrical shape of the eyes, the almost total absence of median and submedian dorsal carinæ, the great width and the uniform increase in width of the hind body, the flattened strap-like shape of the appendages of the exposed thoracic legs, the great length of the curved endopodite of the sixth abdominal appendage, and the presence of acute teeth on the inner margin of its inner spine. There are so many well-marked points of difference, however, that there can be

Measurements.	In inches and decimals.	In thousandths of total length.
Total length from tip of rostrum to tip of telson,	1·806	
Measurements along the middle line :—		
Rostrum,	·075	42
Carapace,	·417	231
Total length of carapace, including rostrum,	·492	273
From posterior margin of carapace to posterior edge of second thoracic somite,	·093	52
From posterior edge of second to posterior edge of third thoracic somite,	·066	37
From posterior edge of third to posterior edge of fourth thoracic somite,	·060	31
From posterior edge of fourth to posterior edge of fifth thoracic somite,	·078	43
First abdominal somite,	·099	55
Second abdominal somite,	·099	55
Third abdominal somite,	·099	55
Fourth abdominal somite,	·099	55
Fifth abdominal somite,	·150	83
Sixth abdominal somite,	·159	88
Telson on middle line,	·312	172
Total length of hind body,	1·314	726
Total length on middle line from tip of rostrum,	1·806	999
Greatest length of telson,	·426	236
Width of carapace between antero-lateral spines,	·186	103
Width of carapace (greatest),	·378	209
Width of second thoracic somite,	·327	181
Width of third thoracic somite,	·291	161
Width of fourth thoracic somite,	·339	187
Width of fifth thoracic somite,	·354	194
Width of first abdominal somite,	·405	224
Width of second abdominal somite,	·438	242
Width of third abdominal somite,	·453	250
Width of fourth abdominal somite,	·501	277
Width of fifth abdominal somite,	·504	278
Width of sixth abdominal somite,	·423	246
Width of telson between postero-median spines,	·117	65
Width of telson between postero-lateral spines,	·306	169
Width of telson (greatest),	·402	222
Length of sixth abdominal appendage,	·597	330
Distance from tip of rostrum to end of eye,	·102	56
Distance from tip of rostrum to tip of first antenna,	·780	401
Length of flagellum of second antenna,	·411	227
Length of scale of second antenna,	·324	170

no doubt of their specific distinctness, nor of the identity of the second species with the single specimen upon which De Haan based his description of *Squilla fasciata*.

The many differences between the two species are noted in the general description, but they are briefly as follows:—

The species may be readily distinguished by the following features. The rostrum of *Squilla lata* is twice as long as wide, and it gradually tapers to the narrow rounded tip, while it is trigonal in *Squilla fasciata*, hardly longer than wide, with a broad tip. The lateral edges of the third and fourth thoracic somites are obliquely truncated in *Squilla lata*, and rounded in *Squilla fasciata*. The paddle of the exopodite of the sixth abdominal appendage of *Squilla lata* is as long, and that of *Squilla fasciata* half as long, as the second joint. The dorsal surface of the telson of *Squilla lata* is obscurely marked by curved lines, and the submedian posterior spines are curved at the tip and broad at the base, with no intermediate dentations; while the dorsal surface in *Squilla fasciata* is marked by longitudinal carinæ, and the submedian spines are acute with intermediate dentations.

In addition to these more conspicuous points, the following minute differences serve to show the distinctness of the two forms:—

The antennæ are longer than in *Squilla lata;* the carapace is nearly transverse in front and deeply notched behind, while in *Squilla lata* it is subacute in front and nearly transverse behind. All the carinæ of the abdominal somites, except the inner pair on the first, end in spines in *Squilla fasciata*, while in *Squilla lata* only those on the sixth somite end in spines, and there is no dorsal spine on the basal joint of the sixth abdominal appendage, while there is an acute spine in *Squilla fasciata*.

The following measurements in thousandths of the total length also exhibit the difference between the two.

	Squilla chlorida.	Squilla lata.	Squilla fasciata.
Length of rostrum,	24	47	42
Length of carapace,	196	205	231
Length of hind body,	781	749	726
Width of third thoracic somite,	168	166	161
Width of fifth abdominal somite,	264	251	278
Length of first antenna, measured from tip of rostrum,	288	287	401
Length of flagellum of second antenna,	232	239	227
Length of scale of second antenna,	96	112	170

Squilla chlorida, n. sp. (Pl. II. figs. 1–5).

? *Clorida decorata*, Wood-Mason, J. Proc. Asiatic Soc., Bengal, Dec. 1875. On some new species of Stomatopoda Crustacea, Ann. and Mag. Nat. Hist., ser. 4, vol. xvii., 1876, p. 263.

? *Chloridella decorata*, Miers, E. J., On the Squillidæ, Ann. and Mag. Nat. Hist., ser. 5, vol. v. p. 15, 1880.

Diagnosis.—Eyes directed forward, with basal portion swollen, and a little wider than corneal portion. Appendages of thoracic limbs strap-shaped. Five teeth on

dactylus of raptorial claw. All the exposed somites of the hind body with lateral dorsal carinæ, but no submedian dorsal carinæ on any of the exposed somites, except the sixth abdominal. Pectinations on inner edge of second joint of raptorial limb undulating. Width of fifth abdominal somite equal to one-fourth of the total length. Inner spine of basal joint of uropod longer than the outer, with a rounded tooth on its outer edge, and on its inner edge four or five acute teeth gradually increasing in size distally. Rostrum wider than long. Dorsal surface of telson with numerous rounded tubercles on each side of median ridge; ventral surface smooth.

Special Description.—Rostrum without a median ridge, a little longer than wide, subtriangular and nearly semicircular. Antero-lateral angles of carapace acute; postero-lateral angles broadly rounded, and prominent; anterior and posterior borders nearly transverse. Carapace without a median carina, and with very faint lines indicating the lateral carinæ; gastric area convex and prominent, with a strongly marked cervical suture. Length of rostrum $\frac{37}{1000}$, and of the carapace $\frac{308}{1000}$, and of the two $\frac{345}{1000}$ of the total length. Exposed thoracic somites increasing gradually in width. First five abdominal somites nearly equal in width, and about equal in width to one-fourth of the total length. The width of the fifth is $\frac{264}{1000}$ of the total length, and it is $\frac{26}{17}$ as wide as the second thoracic somite. There are no submedian dorsal carinæ on any of the exposed somites of the hind body except the sixth abdominal. The first thoracic somite is exposed, and, like the second, has no dorsal carinæ; the third, fourth, and fifth have each a pair of short lateral carinæ, and the first five abdominal somites have each three pairs of lateral carinæ, including the marginal ones, none of which, except those on the sixth abdominal somite, end in spines. The sixth abdominal somite has well-developed submedian, and two pairs of lateral carinæ, all six ending in spines. The first four abdominal somites have each a small median tubercle, which can be detected with difficulty with a lens. The telson has a convex median dorsal ridge, which ends behind in a short acute spine, on each side of which there are numerous scattered rounded tubercles, which obscurely exhibit an arrangement in rows. The ventral surface of the telson is smooth, and the posterior border ends in six pairs of acute spines, with a tuberculated ridge over the base of each postero-median and postero-lateral; a single acute tooth between the lateral and postero-lateral; six or seven acute teeth between each postero-lateral and submedian, and three or four on each side between the tip of the submedian and the deep notch which occupies the middle line. The sixth abdominal appendage is long, and the paddle of the exopodite is oval, about as long as the second joint; the endopodite is long, narrow, and curved; the basal joint carries an acute dorsal spine, and its ventral prolongation ends in a short acute outer spine and a very much longer acute curved inner spine, which has a rounded tooth on its outer margin, and on its inner margin four or five acute curved teeth, which increase in size distally. The rostrum reaches nearly to the base of the ocular somite,

and the eyes are directed forward, side by side, and swollen near the base. The first antennæ are about equal to $\frac{1}{3}$ ($\frac{28}{100}$) of the total length of the body, and their somite ends dorsally in a pair of acute spines which point almost directly forward. The flagellum of the second antenna, including the shaft, is more than $\frac{3}{4}$ ($\frac{23}{28}$) as long as the first, and the scale is only $\frac{1}{10}$ as long as the animal. The width of the carapace between the antero-lateral angles is about half ($\frac{11}{21}$) of its greatest width and about $\frac{1}{3}$ ($\frac{11}{30}$) of its length. The dactylus of the raptorial claw of the second maxilliped is armed with five acute curved teeth, which are finely serrated on their outer edges and increase uniformly in length distally. The second joint has three movable spines on its inner margin, and the pectinations on its outer margin are arranged in an undulating line, with a convexity under each tooth. The appendages of the three pairs of exposed thoracic limbs are strap-shaped and dilated at their tips. The first thoracic somite is entirely exposed dorsally; the second ends laterally in acute spines which are straight and transverse; and the lateral edges of the third and fourth are rounded, with the postero-lateral angles of the fourth a little more acute than the antero-lateral angles. The fifth is obliquely truncated behind. The endopodite of the first abdominal appendage of the male is broad and rounded (Pl. II. fig. 5), and the outer lobe *a* of the terminal joint is subtriangular, and much larger, but shorter, than the inner, which is separated from it by a suture. The fixed limb of the forceps *e* is as long as the movable limb *b*, and it ends in two hooks on its internal edge, one of which points towards the tip and the other towards the base of the appendage.

Habitat.—Amboina, 15 fathoms; one male.

Remarks.—This species bears a close resemblance to *Chlorida decorata*, Wood-Mason, from the Andamans, and to *Chlorida microphthalma*, Eydoux and Souleyet (*Squilla microphthalma*, Milne-Edwards), from India, but it is readily distinguished from the former by the fact that its telson is smooth below, and with scattered rounded tubercles above, while the telson of *Chlorida decorata* is described as vermiculated above and below by granulated ridges.

The presence of four instead of five teeth on the dactyle of the raptorial claw, and the shortness of the rostrum, distinguish it from *Squilla* (*Chlorida*) *microphthalma*, as briefly described by Milne-Edwards; and the presence of five teeth on the raptorial claw, of long acute spines on the lateral edges of the second thoracic somite, and the fact that the postero-lateral angles of the first four abdominal somites are obtuse, distinguish it from *Chloridella microphthalma* (*depressa*) of Miers. The outline and dorsal surface of the telson are also quite different from Miers' figure, while the whole anterior end of the body, especially the rostrum and eyes, is so different from his figure that there can be no doubt of its distinctness.

The genus *Chlorida*, Eydoux and Souleyet (*Chloridella*, Miers) is characterised by the fact that the eyes are constricted at the tip and dilated near the base. It includes four

Measurements.	In inches and decimals.	In thousandths of total length.
Total length from tips of eyes to tip of telson,	1·50	
Measurements on middle line:—		
Total length from tip of rostrum to tip of telson,	1·57	
Rostrum,	·0375	24
Carapace,	·3075	196
Total length of carapace, including rostrum,	·3450	220
From posterior edge of carapace to posterior edge of second thoracic somite,	·0700	45
From posterior edge of second to posterior edge of third thoracic somite,	·0625	40
From posterior edge of third to posterior edge of fourth thoracic somite,	·0675	43
From posterior edge of fourth to posterior edge of fifth thoracic somite,	·0850	54
First abdominal somite,	·1125	72
Second abdominal somite,	·1250	80
Third abdominal somite,	·1125	72
Fourth abdominal somite,	·1250	80
Fifth abdominal somite,	·1475	94
Sixth abdominal somite,	·0875	56
Telson on middle line,	·2275	145
Total length of hind body,	1·2225	781
Total length on middle line,	1·5675	1000
Width of carapace between antero-lateral spines,	·1750	112
Width of carapace (greatest),	·3225	206
Width of second thoracic somite,	·2725	174
Width of third thoracic somite,	·2625	168
Width of fourth thoracic somite,	·2975	190
Width of fifth thoracic somite,	·3125	200
Width of first abdominal somite,	·3750	240
Width of second abdominal somite,	·3774	241
Width of third abdominal somite,	·3824	245
Width of fourth abdominal somite,	·3900	250
Width of fifth abdominal somite,	·4124	264
Width of sixth abdominal somite,	·3974	254
Width of telson, between postero-median spines,	·0824	53
Width of telson, between postero-lateral spines,	·2450	157
Width of telson (greatest),	·3875	248
Greatest length of telson,	·2850	182
Length of sixth abdominal appendage,	·3675	225
Distance between same,	·8000	512
Length of eye,	·1000	64
Width of eye,	·0525	34
Total length of first antenna, measured from tip of rostrum,	·4500	288
Total length of flagellum of second antenna,	·3625	232
Total length of scale of second antenna,	·1500	96

species, one of which, *Chloridella rotundicauda*, Miers, is represented by a single female specimen; another, *Chlorida latreilii*, E. and S., by a single mutilated specimen; while

a third, *Chlorida decorata*, Wood-Mason, is very briefly and inadequately described, and the fourth, *Chlorida microphthalma*, E. and S., by no means satisfactorily known.

Our species would belong to the genus if the shape of the eyes were the criterion, but it is so perfectly connected with *Squilla fasciata*, a true *Squilla*, through the species which was last described, *Squilla lata*, that the propriety of retaining the genus *Chloridella* must remain very doubtful for the present. A comparison of this species (Pl. II. fig. 1), *Squilla lata* (Pl. III. fig. 1), and *Squilla fasciata* (Pl. III. fig. 4), will show that no one of these three species should be placed in a genus which does not include the other two, and as the last is clearly a true *Squilla* I have included all three in this genus.

The comparative table of measurements of the three species which is given at the end of the description of *Squilla fasciata* will also serve to show the close resemblance much better than a description.

Genus *Lysiosquilla*, Dana.

Diagnosis.—Stomatopoda with the sixth abdominal somite separated from the telson by a movable joint; the hind body depressed, loosely articulated and wide; the dactyle of the raptorial claw without a basal enlargement, but with more than six marginal spines; no more than four secondary spines, and often only one, between the intermediate and submedian spines of the telson, which is usually wider than long; and the outer spine of the ventral prolongation from the basal joint of the uropod usually longer than the inner. The larva is an *Erichthus* or *Squillerichthus*, with the ocular and antennulary somites covered by the carapace; the lateral edges of the deep carapace folded inwards over the ventral surface; the bases of the postero-lateral spines distant from the dorsal middle line; the hind body flat and wide; the telson wider than long, and with few spines or only one between the intermediate and submedian spines; and the dactylus of the raptorial claw with numerous marginal spines.

Special Description.—I have examined the first abdominal appendage of the males of two species, *Lysiosquilla maculata* (Pl. X. fig. 6) and *Lysiosquilla excavatrix* (Pl. X. fig. 12), and find such great and characteristic difference from *Squilla*, that I do not hesitate to add to the diagnostic characteristics of the genus the statement that *Lysiosquilla* is distinguished by the fact that the terminal joint of the exopodite of the first abdominal appendage of the adult male is subtriangular, with its large outer lobe separated by a suture from the very small inner lobe, and the fixed limb of the petasma very small and not ending in a hook.

Like the genus *Squilla* the genus *Lysiosquilla* includes two minor groups, a highly specialized one and a more primitive and slightly modified one. The single specimen of *Lysiosquilla* (*Coronis*) *scolopendra* upon which Latreille based his genus *Coronis*, was

very imperfectly described, and it has unfortunately been lost; but his description and the figures which were afterwards published by Milne-Edwards, show such a close resemblance to *Lysiosquilla excavatrix*, n. sp., described below, that there can be no doubt of their very intimate relationship or of the importance of the differences between them and Dana's *Lysiosquilla inornata*, upon which this author based his *genus Lysiosquilla*, which has broad triangular eyes, large antennary scales, filiform appendages to the last three thoracic legs, and the larva of the closely related *Lysiosquilla maculata* has a short rostrum and postero-lateral spines; while *Lysiosquilla* (*Coronis*) *excavatrix* has small subcylindrical eyes, minute antennary scales and uropods, dilated appendages to the last three thoracic limbs, and the rostrum and postero-lateral spines of its larva are very long.

Notwithstanding these important differences the various species agree in many features, such as the presence of numerous spines on the dactyle, and of very few between the submedian and intermediate spines of the telson, in the loose articulation of the wide flat hind body, and the absence of dorsal carinæ. They cannot be arranged in two divergent groups, and it is impossible to draw any abrupt line between them. There can, therefore, be no doubt of the propriety of including them in one genus, as Miers[1] does, retaining Dana's term *Lysiosquilla* for all of them.

The higher and lower forms stand in precisely the same relation to each other as do *Squilla* and *Chloridella*, and there is also a most suggestive similarity in the character of the differences. In fact it is almost as difficult to detect generic differences between *Coronis* and *Chloridella* as between the latter and *Squilla*, or between *Coronis* and the higher *Lysiosquilla*.

The two genera *Squilla* and *Lysiosquilla* are divergent stems from a common stalk, and while the higher forms are quite distinct, the resemblance between the lower forms is no more than we should expect.

While there can be no doubt that all the very wide *Erichthi* with a deep infolded carapace are *Lysiosquilla* larvæ, we cannot state with confidence that all *Lysiosquillæ* have larvæ of this type, for there are no strongly marked and constant differences between the *Lysioerichthus* and the *Gonerichthus* and *Pseuderichthus*, and it is not impossible that some of the narrow elongated *Pseuderichthi* may be *Lysiosquilla* larvæ.

In some of the *Lysiosquillæ*, and possibly in all of them, there are marked secondary differences between the sexes.

Lysiosquilla maculata (Fabricius) (Pl. X. figs. 1–7).

The Challenger collection includes four specimens of this well-known and widely distributed species; one full-grown male, No. 1, presented by the king of Amboina; a half-grown male, No. 3, from Amboina, and a mature male and female, No. 2, from

[1] Miers, On the Squillidæ, p. 3.

Samboangan. Miers has called attention[1] to the fact that in the single female with the large raptorial limbs which he has been able to examine, the spines arming the inner margin of the dactylus, instead of being strong and elongated as in the males, are very short, and towards the base are reduced to little more than small serrations or teeth. The fact that there is the same difference between the raptorial claws of the males and that of the female in the Challenger series would seem to indicate that this difference between the sexes is constant. The raptorial claw of a large male is shown in Pl. X. fig. 1, and that of the female in fig. 2. This difference is the more remarkable as secondary structural differences between the sexes are extremely rare among the Stomatopods. The male of *Pseudosquilla ciliata* is said to be more brilliantly coloured than the female, and the female *Lysiosquilla excavatrix* is larger and darker coloured than the male, but there are no structural differences except the modification of the endopodite of the first abdominal appendage which is found in all male Stomatopods. The sterna of the free thoracic somites of the female *Lysiosquilla maculata* are much thicker and stouter than those of the male, and the median ventral carinæ larger.

The first abdominal appendage of the male is shown in Pl. X. fig. 6. The endopodite is elongated and shorter than the exopodite *ex*, and its terminal joint B is triangular, wider than long, with the inner lobe *h* very much smaller than the outer lobe *a*, from which it is separated by a suture. The inner lobe is nearly circular, with a deep notch on its distal edge; the appendix interna is long and prominent; the movable limb *f* of the forceps is acute and long, while the immovable limb is very small and scarcely visible.

Ontogeny.—The largest *Erichthus* larva in the Challenger collection, a *Lysioerichthus*, is the same as the one shown in Claus's figure 16, and probably identical with *Erichthus duvaucellei*, Guér. It is shown in Pl. X. fig. 7. It is very widely distributed, and the collection contains numerous specimens from various localities in the West Pacific. Specimens were taken in the tow-net between Api and Cape York, between Admiralty Island and the coast of Japan, in the Straits of Mindoro, and at other points, while Claus's specimens were obtained in the Indian Ocean, and Guérin's in the Gulf of Bengal.

Its resemblance to the larva from which I have reared *Lysiosquilla excavatrix* shows that it is a *Lysiosquilla*, and, like *Lysiosquilla maculata*, it is somewhat exceptional, since the inner spine of the uropod is longer than the outer, while most of the adult *Lysiosquillæ*, and most of the *Lysioerichthus* larvae, have the outer spine longest. The raptorial claw is long and slender, and it exhibits traces of eight marginal spines, while the adult female *Lysiosquilla maculata* has seven or eight and the adult male nine.

The abdomen of the oldest larva is marked by the transverse dark bands which are so characteristic of the adult *Lysiosquilla maculata*, and I cannot doubt that this

[1] Miers, On the Squillidæ, p. 6.

Measurements.[1]	In inches.			In thousandths of total length.		
	No. 1.	No. 2.	No. 3.	No. 1.	No. 2.	No. 3.
Total length on middle line from tip of rostrum to tip of telson,	$11\frac{13}{16}$	$9\frac{11}{16}$	$5\frac{30}{32}$			
Rostrum,	$\frac{7}{16}$	$\frac{5}{16}$	$\frac{4}{16}$	·037	·032	·04
Carapace,	$1\frac{15}{16}$	$1\frac{10}{16}$	1	·164	·168	·166
From tip of rostrum to middle of posterior edge of carapace,	$2\frac{6}{16}$	$1\frac{15}{16}$	$1\frac{4}{16}$	·201	·200	·206
From posterior edge of carapace to posterior edge of second thoracic somite,	$\frac{9}{16}$	$\frac{6}{16}$	$\frac{4}{16}$	·048	·039	·04
From posterior edge of second to posterior edge of third thoracic somite,	$\frac{9}{16}$	$\frac{7}{16}$	$\frac{5}{16}$	·048	·045	·05
From posterior edge of third to posterior edge of fourth thoracic somite,	$\frac{11}{16}$	$\frac{9}{16}$	$\frac{6}{16}$	·058	·058	·05
From posterior edge of fourth to posterior edge of fifth thoracic somite,	$\frac{12}{16}$	$\frac{9}{16}$	$\frac{6}{16}$	·063	·058	·05
First abdominal somite,	$\frac{15}{16}$	$\frac{12}{16}$	$\frac{7}{16}$	·079	·077	·07
Second abdominal somite,	$\frac{14}{16}$	$\frac{11}{16}$	$\frac{7}{16}$	·074	·071	·07
Third abdominal somite,	$\frac{14}{16}$	$\frac{12}{16}$	$\frac{7}{16}$	·074	·077	·07
Fourth abdominal somite,	$\frac{14}{16}$	$\frac{12}{16}$	$\frac{7}{16}$	·074	·077	·07
Fifth abdominal somite,	$1\frac{2}{16}$	$\frac{14}{16}$	$\frac{8}{16}$	·095	·09	·08
Sixth abdominal somite,	$\frac{12}{16}$	$\frac{12}{16}$	$\frac{13}{32}$	·063	·077	·067
Telson on middle line,	$1\frac{7}{16}$	$1\frac{4}{16}$	$\frac{14}{16}$	·122	·129	·145
Total length of hind body,	$9\frac{7}{16}$	$7\frac{12}{16}$	$4\frac{22}{32}$	·798	·798	·762
Total length on middle line from tip of rostrum to tip of telson,	$11\frac{13}{16}$	$9\frac{11}{16}$	$5\frac{30}{32}$	·999	·998	·968
Width of carapace at anterior end,	$1\frac{4}{16}$	1	$\frac{11}{16}$	·106	·103	·117
Greatest width of carapace,	$1\frac{14}{16}$	$1\frac{10}{16}$	1	·159	·168	·168
Width of second thoracic somite,	$1\frac{1}{16}$	1	$\frac{9}{16}$	·090	·103	·095
Width of third thoracic somite,	$1\frac{5}{16}$	$1\frac{5}{16}$	$\frac{10}{16}$	·111	·135	·105
Width of fourth thoracic somite,	$1\frac{9}{16}$	$1\frac{8}{16}$	$\frac{12}{16}$	·132	·155	·126
Width of fifth thoracic somite,	$1\frac{11}{16}$	$1\frac{11}{16}$	$\frac{14}{16}$	·143	·174	·147
Width of first abdominal somite,	$2\frac{3}{16}$	$1\frac{15}{16}$	$1\frac{2}{16}$	·185	·200	·189
Width of second abdominal somite,	$2\frac{3}{16}$	$2\frac{1}{16}$	$1\frac{3}{16}$	·185	·213	·200
Width of third abdominal somite,	$2\frac{5}{16}$	$2\frac{1}{16}$	$1\frac{3}{16}$	·196	·213	·200
Width of fourth abdominal somite,	$2\frac{5}{16}$	$2\frac{1}{16}$	$1\frac{3}{16}$	·196	·213	·200
Width of fifth abdominal somite,	$2\frac{4}{16}$	2	$1\frac{3}{16}$	·190	·206	·200
Width of sixth abdominal somite,	$2\frac{2}{16}$	$1\frac{14}{16}$	$1\frac{2}{16}$	·180	·194	·189
Width of telson between postero-median spines,	$\frac{15}{16}$	1	$\frac{10}{16}$	·080	·103	·105
Width of telson between postero-lateral spines,	$1\frac{4}{16}$	$1\frac{9}{16}$	$1\frac{1}{16}$	·159	·161	·179
Greatest width of telson,	$2\frac{2}{16}$	$1\frac{13}{16}$	$1\frac{2}{16}$	·180	·187	·189
Eye stalk,	$\frac{3}{16}$	$\frac{5}{32}$	...	·016	·016	...
Eye,	$\frac{7}{16}$	$\frac{10}{32}$	...	·037	·032	...
Width of eye,	$\frac{8}{16}$	$\frac{7}{16}$	...	·042	·045	...
First antenna, first joint,	$\frac{7}{16}$	...	...	·037	...	...
First antenna, second joint,	$\frac{6}{16}$	...	...	·032	...	...
First antenna, third joint,	$\frac{6}{16}$	...	...	·032	...	...
First antenna, longest flagellum,	$1\frac{8}{16}$	...	...	·127	...	...
Flagellum of second antenna,	2	...	...	·166	...	...
Scale of second antenna,	$1\frac{6}{16}$	...	...	·116	...	...
Antenna of segment,	$\frac{7}{16}$	...	...	·037	...	...
Labrum,	1	$\frac{14}{16}$	...	·084	·090	...

[1] No. 1, adult male; No. 2, adult female; No. 3, half-grown male.

large, widely distributed, transversely banded larva is the young of *Lysiosquilla maculata*, which is one of the largest and most widely distributed Stomatopods. The value of this identification can be much better estimated after examination of the section on Stomatopod larvæ.

Lysiosquilla (*Coronis*) *excavatrix*, n. sp. (Pl. X. figs. 8–16).

Diagnosis.—Body depressed and loosely articulated; whole dorsal surface smooth. Carapace, with rostrum, making $\frac{17}{100}$ of the total length from tip of rostrum to tip of telson. Eyes nearly cylindrical, with hemispherical corneæ. Scale of second antenna about $\frac{4}{100}$ of total length. Raptorial claw of second maxilliped oval, with fourteen or fifteen short curved pointed teeth and a much longer terminal tooth on dactylus, and three movable spines on inner side of base of second joint. Second thoracic somite with a blunt rounded lobe on each side. Appendages of third, fourth, and fifth pereiopods ovate, that of the fourth being largest. Sixth abdominal somite with a long acute process on each side, near anterior edge. Telson smooth, nearly rectangular, with one median and two pairs of lateral subacute lobes. Endopodite of sixth abdominal appendage triangular, basal prolongation ending in two simple acute curved spines, the outer much the larger. Larva a long-spined *Lysioerichthus*.

General Description.—The carapace is smooth on its dorsal surface, with the gastric sutures distinct from the anterior edge to the transverse cervical suture, behind which no longitudinal sutures are visible. The space included between the gastric sutures is wide and makes up rather more than two-thirds of the total width of the carapace. This is elongated and slightly narrowed anteriorly, with the antero-lateral angles nearly right angles and the postero-lateral angles broadly rounded. The anterior edge of the carapace is nearly transverse, and it is very deeply emarginated on the middle line behind. Its length on the middle line is $\frac{17}{100}$, and its greatest breadth about $\frac{12}{100}$ of the total length. The rostrum is a little longer than wide and the lateral edges are not angulated, but are strongly convex in outline and regularly curved to the base of the short acuminate tip. The rostrum completely covers the ocular somite, and hides the base of the eyes. The first antennary somite ends laterally in long slender acute spines, which curve outwards and forwards.

The first antennæ are very short and their shafts are hidden nearly to the tips below the eyes, which are small, subcylindrical, with terminal hemispherical corneæ, and are usually directed forwards side by side. The second antennæ are almost as long as the first, and the oval scale is very narrow and short, its length being only $\frac{35}{1000}$ of the total length of the body.

The second joint or propodus of the raptorial claw is broad, with an obscure longitudinal ridge on its outer surface, and when the dactylus is closed the claw is oval and nearly

flat. The dactylus (Pl. X. fig. 11) is armed with fourteen or fifteen sharp curved teeth, besides the terminal tooth, which is more than three times as long as any of the others. There are three stout movable spines on the inner edge of the second joint near the base, while the outer edge is fringed with numerous small immovable pectinations.

The carapace does not completely hide the dorsal surface of the first thoracic somite. The second thoracic somite is prolonged on each side near its posterior edge into a rounded lobe which projects backwards, while the lateral edges of the third, fourth, and fifth thoracic somites are entire and longitudinal, with rounded antero- and postero-lateral angles.

The thoracic somites are much narrower than the carapace, and they increase regularly in width from the second to the fifth, which is less than two-thirds as wide as the first abdominal. The first five abdominal somites are nearly equal in width and also in length, their transverse diameter being about $\frac{14}{100}$ and their average length about $\frac{10}{100}$ of the total length of the body. They are a little ($\frac{7}{6}$) wider than the carapace. The sixth abdominal somite is considerably narrower than the fifth, and slightly narrower than the carapace, its transverse diameter being less than $\frac{10}{100}$ of the total length of the body. It is about twice as wide as long. On the lateral margin on each side, close to the anterior edge, there is a prominent acute curved process, but its posterior edge is entire, and the suture which separates it from the telson is very obscure, but movable. The whole dorsal surface of the rostrum, carapace, hind body, and telson is smooth and highly polished, and without carinæ or spines.

The telson is as wide as the sixth abdominal somite, nearly rectangular, and $\frac{7}{12}$ as long as wide, its length being about $\frac{7}{100}$ of the total length of the body. Its posterior edge is transverse, as long as the anterior edge, and nearly straight, and it is divided, in the adult, by four concave notches into five subacute lobes, of which one is on the middle line, and two on each side, all nearly equidistant. In the young the median lobe is represented by a pair of submedian spines, with minute setæ on the margin of the telson between them.

The exposed thoracic limbs are short and their appendages are broad, oval, and membranous. The uropods are small and little used in locomotion; the endopodite is triangular, and the ventral prolongation from the basal joint ends in two acute, curved, unarmed spines, of which the outer is much the larger. The anterior process of the mandible is bordered by two rows of irregular obtusely rounded dentations, which are continued to the tip where there are two terminal dentations. The endopodite of the first maxilla, fig. 9, ends in a stout acute curved spine, which carries on its outer surface two stout movable hairs and one slender one. The outer surface of the second maxilla, fig. 10, is smooth, and is not divided into lobes by a median furrow.

The first five pairs of abdominal appendages are furnished with very large exopodites

which overlap on the middle line. The endopodite of the first abdominal appendage of the male is shown in Pl. X. fig. 12. It is very much smaller than the exopodite, triangular, and as wide as long. The inner lobe *b* of the terminal joint is very small, nearly circular, and separated by a suture from the broad triangular outer lobe *a*. The movable limb of the petasma is long, nearly straight, and armed on its outer edge, near the base, with an acute spine, while the fixed limb is very short and without a hook at the tip, which is rounded, as is the case in *Lysiosquilla maculata*. The sexes of this species are quite different from each other, and it seems probable that secondary sexual differences may occur in all the flat loosely articulated Stomatopods.

The character of the difference between the sexes is however quite different from what we find in *Lysiosquilla maculata*. In the latter species the sexes are alike in size and colour, and they differ in structural features, while in this species there are no structural differences except those which are concerned in reproduction, but the female is much larger than the male, and of an opaque olive brown, almost black colour, while the male is of a transparent grey.

Habits.—As our information regarding the habits of the Stomatopoda is very scanty, I give all that I have been able to learn of the habits of this species. It is found in the sand of the ocean beach just below low-tide mark, where it is exposed to the full force of the ocean swell, and it inhabits a very deep cylindrical burrow which is nearly vertical and goes down for several feet. While watching for its prey the animal stations itself at the mouth of the burrow, which is arched over with sand, so that only the tips of the eyes are exposed. The food consists of small Crustacea, fishes and other small animals, and when one approaches within reach the *Coronis* darts out of the burrow, knocking away the loose sand, and seizing it in its raptorial claw it darts backwards with it and retreats to the bottom of the burrow. When hungry it often captures prey at a distance of six or eight inches, but, as a rule, it waits until it is near enough to be caught without leaving the opening. The food which is captured is usually stored away at the bottom of the burrow, and the animal returns to the mouth and resumes its watch. In excavating its burrow the animal begins by stretching its body out on the sand, which is then swept away from under it by the action of the abdominal appendages, until all of the body except the eyes and telson are buried. It then forces its head into the loose sand which has been stirred up by the action of the abdominal appendages, and dragging its body down it quickly becomes buried vertically, head downwards, and it continues to burrow until it reaches the hard undisturbed sand, when it bends upon itself, and passing the head up on the ventral side of the swimmerets it reverses its position and works upwards to the surface, hardening and compressing the sand by the pressure of the dorsal surface. After the upper end of the burrow is thus rendered firm and circular it again doubles upon itself, and going to the bottom gathers an armful of sand, which is clasped against the ventral surface of the body between the large second maxillipeds, where it is

held in place by the flat oval chelæ which are tightly clasped over it. At the opening it stretches out as far as it can reach without leaving the burrow, and dropping the armful of sand it smooths it down until it is level with the surrounding surface. This process is then repeated until the burrow reaches a great depth, for I have dug for three or four feet without reaching the end, and all the specimens which I kept in confinement burrowed to the bottom of the aquarium.

When the burrow is finished the animal spends most of its time near the top, and as the semicircular exopodites of the abdominal appendages complete the outline formed by the convex dorsal surface, it completely fills the circular tube, into which the constantly vibrating scoop-like abdominal appendages carry a continuous current of water, which escapes through the loose sand.

The whole organisation of the species,—the convex body, the semicircular swimmerets, the small closely approximated eyes, and the broad flat claws,—adapt it for its mode of life, and it is doubtful whether any other species is more completely subterranean in its habits. Although it is very common at Beaufort, I have captured only one specimen while swimming, and it very rarely ventures more than a few inches from the burrow.

Its movements when seizing its prey are so rapid that the eye can scarcely follow them, and the attempt to cut off its retreat with a trowel usually results in cutting the animal in two, although this is the only method of capturing them which I have found at all successful.

This species, when kept in confinement, makes a faint stridulating noise by rubbing the uropod against the lower surface of the telson. *Squilla empusa* stridulates vigorously in the same way, and its habits, which I have also had an opportunity to observe, are quite different from those of *Lysiosquilla excavatrix*. It is very active, swimming swiftly through the water, and pursuing its prey to a great distance from its burrow, so that it is frequently captured in the water by the trawl or sein. It inhabits muddy rather than sandy bottoms, and its burrow is a shallow U-shaped tube, open at both ends, and excavated entirely by the action of the current of water which is set up by the abdominal appendages.

Ontogeny.—Lysiosquilla excavatrix is one of the few Stomatopods which have been traced through their metamorphoses, and the fully grown larva, which is a long-spined *Lysioerichthus*, is shown in Pl. XI. figs. 1–3.

I shall show in the section on Stomatopod larvæ that it probably hatches as an *Erichthoidina*, with five pairs of biramous thoracic appendages; the sixth, seventh, and eighth thoracic somites distinct but without appendages, and the telson joined to the last thoracic somite with no intervening abdominal region. In the youngest *Erichthus* stage, however, there is a long segmented abdomen with four pairs of fully developed appendages, and the thoracic somites from the third to the eighth have no appendages, while those of the first and second thoracic somites have their adult form. The lateral edges of

the young *Erichthus* are bordered with spines as in *Alima*, and the general structure of the larva is very *Alima*-like; a resemblance which totally disappears in the older larvæ.

Habitat.—Common below low water mark on sandy beaches at Beaufort, N.C., U.S.A.

Measurements.	In hundredths of inch.		In thousandths of total length.	
	Large male.	Large female.	Large male.	Large female.
Total length on middle line from tip of rostrum to tip of telson,	2·41	3·02	...	...
Rostrum,	·10	·11	·041	·036
Carapace,	·33	·39	·137	·129
Total length of carapace and rostrum,	·43	·50	·178	·165
From posterior edge of carapace to posterior edge of second thoracic somite,	·04	·12	·017	·039
From posterior edge of second to posterior edge of third thoracic somite,	·10	·14	·041	·046
From posterior edge of third to posterior edge of fourth thoracic somite,	·13	·17	·054	·056
From posterior edge of fourth to posterior edge of fifth thoracic somite,	·16	·20	·066	·073
First abdominal somite,	·24	·28	·100	·092
Second abdominal somite,	·25	·29	·104	·095
Third abdominal somite,	·25	·30	·104	·099
Fourth abdominal somite,	·26	·30	·108	·099
Fifth abdominal somite,	·25	·30	·104	·099
Sixth abdominal somite,	·13	·18	·054	·059
Telson,	·17	·24	·070	·079
Total length of hind body,	1·98	2·52	·822	·836
Total length on middle line,	2·41	3·02	1·000	1·001
Width of carapace at anterior end,	·20	·24	·083	·079
Greatest width of carapace,	·30	·33	·125	·109
Width of second thoracic somite,	·13	·22	·054	·073
Width of third thoracic somite,	·22	·30	·091	·099
Width of fourth thoracic somite,	·24	·32	·100	·106
Width of fifth thoracic somite,	·25	·34	·104	·112
Width of first abdominal somite,	·31	·45	·129	·149
Width of second abdominal somite,	·31	·46	·129	·152
Width of third abdominal somite,	·32	·46	·133	·152
Width of fourth abdominal somite,	·32	·46	·133	·152
Width of fifth abdominal somite,	·31	·46	·129	·152
Width of sixth abdominal somite,	·26	·34	·108	·112
Greatest width of telson,	·29	·36	·120	·119
Length of first antenna from tip of rostrum to tip of longest flagellum,	·38	·36	·158	·119
Length of appendage of second antenna,	·35	...	·145	...
Length of scale of second antenna,	·08	·12	·032	·04
Length of eye,	·09	·09	·037	·029
Total length of swimmeret,	·38	·42	·158	·139

Size.—Males from two to three inches long; females from two and one-half to four inches long.

Colour.—Males transparent, with small dark brown pigment spots uniformly distributed, giving the body a greyish tint; females more opaque and of a dark olive brown, nearly black, colour.

Remarks.—This species seems to be very closely related to *Lysiosquilla polydactyla*, but there can be no doubt of its specific distinctions.

Genus *Pseudosquilla*, Guérin.

Diagnosis.—Stomatopoda with the sixth abdominal somite separated from the telson by a movable joint; the hind body smooth, convex, and narrow; the dactyle of the raptorial claw without a basal enlargement, and with few marginal spines or none; the submedian spine of the telson long, and tipped with movable spinules, with usually a single secondary spinule, sometimes two, three, or four, between the submedian and intermediate marginal spines; the terminal joint of the first abdominal appendage of the male imperfectly divided by a marginal notch into an inner and an outer lobe; larva an elongated narrow *Erichthus*, with a short narrow carapace, with the postero-lateral spines near the dorsal middle line, and the lateral edges slightly or not at all infolded; the telson longer than wide, with long submedian spines; the proximal joint of the exopodite of the uropod with numerous spines, and the outer spine of the basal prolongation much longer than the inner and longer than the telson.

Pseudosquilla ciliata, Miers (Pl. XV. fig. 10).

Pseudosquilla ciliata, Miers, Ann. and Mag. Nat. Hist., ser. 5, vol. v. p. 108, pl. iii. figs. 7, 8.

The Challenger collection includes two specimens of this well-known species, a male and a female, from 2 fathoms depth at St. Thomas, and also a male from the reefs at Honolulu.

The raptorial claws, the spines of the telson, and the paddles and spines of the uropods retain, in the alcoholic specimen, the bright cherry red colour which, according to G. Clark, is exhibited by the living animal. The alcoholic specimens also have eye-like spots of black pigment near the lateral edges of the third thoracic and first abdominal somites, and another on the dorsal surface of the base of the telson on the middle line. The occurrence of this Pacific species at St. Thomas is a remarkable fact in the distribution of the Stomatopoda, but it will probably be found to be widely distributed throughout the Atlantic as well as the Pacific, for Von Martens records it from Cuba. The specimens from St. Thomas agree perfectly in measurements as well as in most other respects with the one from Honolulu. The only differences which I have been able to detect are the following: the paddle of the exopodite of the uropod is about as long as the second joint in the specimens from the Pacific, while it is a little shorter in the two

Measurements of male specimen from Honolulu.	In inches and decimals.	In thousandths of total length.
Total length on middle line, from tip of rostrum to edge of telson	2·13	
Measurements on middle line:—		
Rostrum,	·12	56
Carapace,	·54	254
Carapace, including rostrum,	·66	310
From posterior edge of carapace to posterior edge of third thoracic somite,	·12	56
From posterior edge of third to posterior edge of fourth thoracic somite,	·10	47
From posterior edge of fourth to posterior edge of fifth thoracic somite,	·10	47
First abdominal somite,	·16	75
Second abdominal somite,	·16	75
Third abdominal somite,	·16	75
Fourth abdominal somite,	·16	75
Fifth abdominal somite,	·22	104
Sixth abdominal somite,	·14	66
Telson on middle line,	·15	70
Total length of hind body,	1·47	690
Total length on middle line,	2·13	1000
Greatest length of telson,	·38	178
Width of rostrum,	·20	94
Width of carapace at antero-lateral angles,	·32	150
Width of carapace (greatest),	·44	208
Width of third thoracic somite,	·42	197
Width of fourth thoracic somite,	·42	197
Width of fifth thoracic somite,	·42	197
Width of first abdominal somite,	·46	216
Width of second abdominal somite,	·46	216
Width of third abdominal somite,	·46	216
Width of fourth abdominal somite,	·46	216
Width of fifth abdominal somite,	·46	214
Width of sixth abdominal somite between postero-lateral spines,	·38	178
Width of telson (greatest),	·38	178

specimens from St. Thomas; the specimen from Honolulu has the inner spine of the ventral prolongation from the base of the uropod much longer than the outer, while the two spines are of equal length in the two specimens from St. Thomas; in the specimens from St. Thomas the postero-lateral angles of the fourth, fifth, and sixth abdominal appendages end acutely in spines, while this is the case with the fifth and sixth only in the specimen from Honolulu. In all the specimens the lateral lobes of the last thoracic somite are bidentate.

Miers is undoubtedly correct in his decision that v. Marten's *Pseudosquilla stylifera* from Cuba is a *Pseudosquilla ciliata*, and it is probable that it ranges very widely over

both the Atlantic and the Pacific, with slight differences between the specimens from widely separated localities, and *Pseudosquilla oculata*, Brullé, from the Canaries and Madeira, may possibly prove to be one of these varieties of *Pseudosquilla ciliata*, but the species of *Pseudosquilla* all need careful revision, as there is evidently considerable variability. Peculiarities of colouration are unsafe guides in the study of preserved specimens, and most of the other marks for the discrimination of species are known to vary. Thus Heller says that his *Pseudosquilla oculata* (*Pseudosquilla ornata*, Miers) may be distinguished from *Pseudosquilla stylifera* (*Pseudosquilla ciliata*, Miers) by the fact that the spine of the uropod is longer than the endopodite, but Miers' figure of *Pseudosquilla ciliata* (Squillidæ, pl. iii. fig. 8) represents the spine as longer than the endopodite uropod, and this is true of the Challenger specimens also.

Genus *Gonodactylus*, Latreille.

Diagnosis.—Stomatopoda with the sixth abdominal somite separated from the telson by a movable joint; the hind body convex; and the dactylus of the raptorial claw enlarged at the base, and without marginal spines. Larva, an *Erichthus*, has the postero-lateral spines of the carapace near the dorsal middle line, the lateral edges not infolded, and hatches from the egg as an *Erichthoidina*, which becomes converted into an *Erichthus* without the loss of any of its appendages.

Remarks.—All the Stomatopods with a dilated unarmed dactylus on the second maxilliped are usually grouped in a single genus, *Gonodactylus*, but the collection of species which are thus brought together is a very heterogeneous one, and little examination is necessary to show that the genus, as usually characterised, includes at least three distinct assemblages of species. The species which have the sixth abdominal somite immovably fused with the telson are obviously more closely related to each other than they are to the other species of *Gonodactylus*, and as this fact should find its expression in the systematic zoology of the group I have placed these species by themselves in a distinct genus *Protosquilla*, retaining in the genus *Gonodactylus* only those species which have the telson movable. In the genus as thus restricted, two species, *Gonodactylus* (*Squilla*) *bradyi*, A. Milne-Edwards, and *Gonodactylus trachurus*, Miers, differ from all the remaining species in many features, such as the small size of the eyes, the scales of the second antennæ and the uropods; the depression of the hind body, and the presence of dentations on the inner edge of the dactylus of the raptorial claw. The propriety of separating these species from the true *Gonodactyli* seems obvious, and as they present many points of resemblance to both *Lysiosquilla* and *Squilla*, especially to the least specialised species in these two genera, I suggest for them the generic name, *Coronida*, compounded from *Coronis*, the generic name proposed by Latreille for the *Lysiosquillæ* with dilated appendages on the exposed thoracic limbs, and *Chlorida*,

the generic name proposed by Eydoux and Souleyet for the small-eyed *Squillæ*. The genus *Coronida* will therefore include the Stomatopods which have the dactyli of the raptorial claw dilated at the base and armed with spines on the inner margin, and the hind body depressed; while the genus *Gonodactylus*, as thus restricted by the removal of the *Protosquillæ* and the *Coronidæ*, will include only the species which have the hind body convex, the dactylus of the raptorial claw dilated at the base and unarmed, and the telson distinct and movable.

In the genus *Gonodactylus* as thus restricted the terminal joint of the first abdominal somite of the male is imperfectly divided, by a marginal notch, into an outer and an inner lobe, which are not separated by a suture (see Pl. XV. fig. 8).

The fixed limb of the petasma is short, and ends in a single acute hook, while the movable limb is abruptly bent outwards near its base.

Gonodactylus chiragra, Latreille (Pl. XV. fig. 4).

This common and widely distributed species is represented in the Challenger collection by numerous males and females from St. Thomas, one male from Bermuda, one male from Station 36, near Bermuda (32° 7′ 25″ N., 65° 4′ W.), by two specimens from Samboangan, and one specimen from Samboangan Bank, besides numerous adult male and female specimens of a closely related but minute variety from near Cape St. Roque. The appendages of the exposed thoracic limbs of all the specimens of *Gonodactylus chiragra* are slightly flattened, and twice as wide as thick, and their edges are parallel and not dilated at the tip. The second joint of the exopodite of the uropod is more than twice as long as the paddle, and it carries about eleven (ten in four specimens, eleven in seven specimens, nine or ten in Heller's specimen from Nicobars, twelve in two specimens) movable spines and one terminal ventral immovable spine.

The terminal joint of the endopodite of the male *Gonodactylus chiragra* is divided by a deep marginal notch into an outer lobe (Pl. XV. fig. 4) *a* and an inner one *b*, which is not separated from the outer one by a suture. The fixed limb of the petasma *e* is short, swollen at the base, and bent inwards at right angles at the tip, thus forming a hook which ends in an acute point. The much longer movable limb *f* is bent outwards in a prominent sharply defined obtuse angle near its base.

There seems to be no room for doubting that the specimens from various parts of the ocean which have been described as *Gonodactylus chiragra* really belong to one species, and that it is very widely distributed throughout the Atlantic, the Pacific, and the Indian Oceans. E. v. Martens says[1] that although he has formerly published his opinion that this species is confined to the Indian Ocean, and the Pacific from the Red Sea to Chili, the

[1] Ueber cubanische Crustaceen, nach den Sammlungen Dr. J. Gundlach's, *Archiv f. Naturgesch.*, 1872, Jahrg. xxxiii., Bd. ii. p. 147.

Measurements of a female, *a*, from Bermuda and a male, *b*, from Samboangan.	In inches and decimals.		In thousandths of total length.	
	a.	*b.*	*a.*	*b.*
Measurements along middle line :—				
Rostrum,	·12	·18	60	69
Carapace,	·43	·66	215	222
Carapace, including rostrum,	·55	·78	275	289
From posterior edge of carapace to posterior edge of third thoracic somite,	·10	·14	50	52
From posterior edge of third to posterior edge of fourth thoracic somite,	·12	·14	60	52
From posterior edge of fourth to posterior edge of fifth thoracic somite,	·12	·14	60	52
First abdominal somite,	·14	·19	70	69
Second abdominal somite,	·14	·22	70	81
Third abdominal somite,	·16	·22	80	81
Fourth abdominal somite,	·18	·20	90	74
Fifth abdominal somite,	·19	·24	95	89
Sixth abdominal somite,	·12	·16	60	59
Telson on middle line,	·18	·27	90	100
Total length of hind body,	1·45	1·92	725	709
Total length on middle line,	2·00	2·70	1000	998
Greatest length of telson,	·29	·40	145	148
Width of carapace between antero-lateral angles,	·25	·34	125	126
Width of carapace (greatest),	·32	·46	160	170
Width of sixth thoracic somite,	·32	·50	160	185
Width of seventh thoracic somite,	·33	·50	165	185
Width of eighth thoracic somite,	·33	·50	165	185
Width of first abdominal somite,	·34	·52	170	192
Width of second abdominal somite,	·35	·52	175	192
Width of third abdominal somite,	·35	·52	175	192
Width of fourth abdominal somite,	·35	·52	175	192
Width of fifth abdominal somite,	·35	·52	175	192
Width of sixth abdominal somite between postero-lateral spines,	·32	·44	160	163
Width of telson between sub-median spines,	·11	·14	55	52
Width of telson (greatest),	·30	·44	150	163
Length of eye,	·14	...	70	...
Length of first antenna from tip of rostrum,	...	·42	...	155
Length of second antenna from tip of rostrum,	...	·56	...	207
Length of scale,	...	·32	...	118

absence of any decided difference between the specimen obtained in Cuba by Gundlach and those which he has himself collected at Amboina compels him to reverse this opinion and to recognise the occurrence of the species in the tropical Atlantic. He says that the specimens from the Atlantic are smaller on the average than those from the Indian Ocean, that the rostral spine is a little shorter. He points out also a slight variation among the Cuban specimens in the terminal spines

of the telson, as well as slight differences in the colour of the alcoholic specimens from the two previous localities.

Smith says[1] that specimens from the West Indian and Florida Keys do not differ from those collected at the Reefs of the Abrolhos at Caravella, Province of Bahia, Brazil, by Hartt, but he says that "the American species is, however, very likely distinct from the true *Gonodactylus chiragra*, from the Old World," although he gives no reason for this opinion. A. Milne-Edwards[2] records it from the Mediterranean, and coasts of America, Africa, Asia, and Oceania. Miers says that he has examined a specimen four inches long from New Guinea.

Gonodactylus graphurus, Miers (Pl. XIV. figs. 1, 4, 6; Pl. XV. figs. 3, 8).

Gonodactylus graphurus, Miers, Edw. J., On some new or undescribed Crustacea from the Samoan Islands, Ann. and Mag. Nat. Hist., ser. 4, vol. xvi. p. 344, 1875.

Gonodactylus graphurus, Miers, Edw. J., On the Squillidæ, Ann. and Mag. Nat. Hist., ser. 5, vol. v., 1880, p. 120, pl. iii. fig. 9.

Gonodactylus graphurus, White, List of Crustacea, Brit. Mus., 1849, p. 85 (no description).

Gonodactylus graphurus, Miers, Edw. J., Malaysian Crustacea, Ann. and Mag. Nat. Hist., ser. 5, vol. v. p. 459, 1880.

Diagnosis.—Dactylus of raptorial claw without teeth and dilated at base. Rostrum with a long slender acute median spine and subacute antero-lateral angles. Hind body wider than the carapace, with its sides straight and parallel. Second thoracic somite partially exposed dorsally. Lateral edges of all the abdominal somites with triangular marginal carinæ with the apices directed backwards. Dorsal surface of the thoracic and first five abdominal somites without carinæ or spines. Sixth abdominal somite with a short unarmed median carina, and three pairs of swollen convex lateral carinæ, all ending in spines, the second or intermediate shorter than the first and third. Telson ending in six acute spines with broad bases, each one with a broad convex longitudinal dorsal carina. Middle of dorsal surface of telson with a protuberant hemispherical eminence, upon which are five very broad convex carinæ, of which the median and submedian end posteriorly in acute spines, while the marginal ones are without spines and shorter than the others. There is a triangular subacute prominence on the anterior edge of the telson on each side, halfway between the middle line and the lateral margin, with a broad convex carina. Paddle of exopodite of uropod half as long as the second joint. Basal joint of uropod with two acute spines on dorsal surface, while its ventral prolongation ends in two nearly equal acute spines, with a rounded tooth on inner edge of outer one near the base. Tergal surfaces of the first five abdominal somites with longitudinal sutures on sides, and a transverse dorsal suture.

General Description.—Carapace flat, hind body convex, and highly polished.

[1] Brazilian Crustacea, *Trans. Conn. Acad.*, vol. ii. p. 31, 1869. [2] *Nouv. Arch. Mus. Hist. Nat.*, t. iv. p. 65, 1868.

Rostrum consisting of a transverse proximal portion more than twice as wide as long, with subacute antero-lateral angles, and a long slender median acute spine which reaches beyond the bases of the eyes (see fig. 6). Carapace nearly rectangular, three-fifths as long as wide, leaving the dorsal surface of the second thoracic appendage almost completely exposed, with broadly rounded antero-lateral and more acutely rounded postero-lateral angles. The antero-lateral angles project forwards beyond the median gastric area, which is very slightly convex and a little wider posteriorly than anteriorly, and bounded by two nearly straight gastric sutures which run from anterior to posterior edge. Transverse cervical suture almost invisible. Posterior edge of carapace transverse. Second thoracic somite as wide as carapace. The eight following somites equal in width, and wider ($\frac{179}{155}$) than the carapace. The lateral margins of the third thoracic somite are straight, with rounded angles, and as wide as the dorsal portion; the fourth is narrowed a little towards the lateral edge, and the fifth still more. There is a median impressed line on the dorsal surface of the third and one on the fourth thoracic somite. All the abdominal somites have marginal carinæ which are wide in front and gradually become narrow towards the postero-lateral angle, which is rounded in the first four segments, rectangular in the fifth, and ending in an acute spine in the sixth (see fig. 1). There are no dorsal carinæ on the first five abdominal segments. The sixth (see Pl. XIV. fig. 4) has a short unarmed median carina and three pairs of lateral carinæ, which terminate posteriorly in acute spines and are greatly swollen, so that they together occupy more than half the dorsal surface of the somite, convexly rounded, and widening anteriorly. The spines of the submedian and marginal carinæ project beyond the posterior edge of the somite, while those of the intermediate carinæ barely reach it. The second, third, fourth, and sixth abdominal somites are equal in length, and longer than the first and shorter than the fifth. A strongly impressed suture (see Pl. XIV. fig. 1) crosses the middle line of each of the first five abdominal somites near the posterior border, and bends forwards on the side of the somite, and each of these somites has also a lateral longitudinal suture on each side, branching upwards at its posterior edge.

The telson is considerably wider than long ($\frac{169}{145}$) and its dorsal surface is folded into a very graceful pattern which can hardly be satisfactorily described, although it can be understood by comparing the profile view, fig. 1, with the surface view shown in fig. 4. The median portion is occupied by a hemispherical prominence, upon which are five meridional carinæ, which are convexly rounded and so greatly swollen that they almost completely cover it. Three of these, the median and submedians, are abruptly rounded and emarginated at their posterior ends, where they end in acute spines, while the third or marginal pair do not end in spines and are much shorter.

On each side of the median prominence there is on the anterior edge of the telson a triangular prominence with a broad rounded subacute carina, and outside this, and near the antero-lateral angle, there is a transverse rounded prominence without a keel, and a

short transverse keel at the antero-lateral angle. The posterior edge of the telson is folded into six acute spines, and from the tip of each a broad convex carina runs forwards on the dorsal surface of the telson. The marginal carina reaches to the anterior border, the intermediate stops a little short of this border, and the third or submedian runs forwards for about half the length of the telson, where it abuts upon the median prominence.

The marginal spines of the telson have acute tips and swollen bases with convexly rounded outlines, and the deep sulci between them are bordered by convex ridges. The outer spine is simple; the intermediate has its outer edge simple and a secondary spine on its inner edge near its base; the submedian spine has a secondary spine on its outer edge near its base, and twelve or thirteen acute dentations on its inner edge. The dorsal surface of the basal joint of the uropod ends posteriorly in two acute spines, and there is a rounded lobe outside the base of the outer one; its ventral surface ends posteriorly in a process divided into two acute curved spines, the outer longer and with a rounded tooth near its base on its inner edge.

The paddle of the exopodite is more than half ($\frac{1}{2}\frac{3}{2}$) as long as the second joint, which has a rounded process on the inner edge of its base, about twelve movable spines on its outer edge, and a ventral terminal immovable spine.

The eyes are cylindrical, with rounded corneæ (fig. 6), and the first and second antennæ are about equal in length. The eyes hide all the shaft of the first antenna except the terminal joint. The tip of the simple dactyle of the raptorial claw is curved outwards, and its inner edge is barbed with minute serrations.

The endopodite of the first abdominal appendage of the male (Pl. XV. fig. 8) is very similar to that of *Gonodactylus chiragra*. The terminal joint is divided by a deep marginal notch into a small outer lobe and a large inner lobe, both of which are rounded and not separated by a suture. The fixed limb *e* of the petasma is swollen at the base and it ends in a single acute hook.

Remarks.—Notwithstanding the fact that this is a widely distributed species, no minute description of it has been published, as Miers' description[1] gives little except the points of difference from *Gonodactylus chiragra*, and the only figure, the telson shown in Miers' fig. 9, is misleading, as will be seen by comparison with our fig. 4, Pl. XIV. In his figures, as well as in his descriptions, he represents the central area of the dorsal surface of the telson as made up of three pairs of curved carinæ on the sides of the median one, whereas more careful examination will show that the third or outermost pair do not belong to the central elevated convex system so characteristic of this and related species, but to a distinct eminence on the anterior edge of the telson.

This species is very closely related to *Gonodactylus chiragra*. The species next described, *Gonodactylus glabrous*, is in many respects intermediate between the two, the three forming a sharply defined natural group or subgenus. It may readily be

[1] *Ann. and Mag. Nat. Hist.*, ser. 4, vol. xiv. p. 344, and ser. 5, vol. v. p. 120.

Measurements of a male specimen from near Cape York.	In inches and decimals.	In thousandths of total length.
Total length from tip of rostrum to middle of posterior edge of telson,		2·14
Measurements on middle line :—		
Rostrum,	·15	70
Carapace,	·51	238
Carapace, including rostrum,	·66	308
From posterior edge of carapace to posterior edge of third thoracic somite,	·14	65
From posterior edge of third to posterior edge of fourth thoracic somite,	·10	47
From posterior edge of fourth to posterior edge of fifth thoracic somite,	·10	47
First abdominal somite,	·12	56
Second abdominal somite,	·16	75
Third abdominal somite,	·16	75
Fourth abdominal somite,	·16	75
Fifth abdominal somite,	·20	93
Sixth abdominal somite,	·16	75
Telson on middle line,	·18	84
Total length of hind body,	1·48	692
Total length on middle line,	2·14	1000
Total length of telson,	·31	145
Width of rostrum,	·16	75
Width of carapace between antero-lateral angles,	·26	122
Width of carapace (greatest),	·33	155
Width of third thoracic somite,	·38	179
Width of fourth thoracic somite,	·38	179
Width of fifth thoracic somite,	·38	179
Width of first abdominal somite,	·38	179
Width of second abdominal somite,	·38	179
Width of third abdominal somite,	·38	179
Width of fourth abdominal somite,	·38	179
Width of fifth abdominal somite,	·38	179
Width of sixth abdominal somite, between postero-lateral spines,	·33	155
Width of telson between submedian spines,	·10	47
Width of telson between intermediate spines,	·26	122
Width of telson (greatest),	·34	160
Length of paddle of exopodite of uropod, on dorsal surface,	·13	61
Width of second joint of exopodite of uropod, on dorsal surface,	·22	103

distinguished from *Gonodactylus chiragra* by the presence of five instead of three carinæ on the median protuberance of the telson, and by the presence of acute spines on the posterior ends of three of them, by the possession of six instead of four spines on the posterior border, and by the presence of a tooth on the inner edge of the outer spine of the ventral prolongation of the uropod. It is more difficult to distinguish it from *Gonodactylus glabrous*, which it resembles very closely. The many minute differences will be pointed out in the description of this species.

Colour.—The alcoholic specimens have the carapace mottled with dark brown pigment, with four sharply defined dark spots close to its posterior edge, six elongated pigment spots on the third, six on the fourth, four on the fifth, and four on each of the first five abdominal somites. Miers says that his specimens from the Samoan Islands were dull olive green, with branchial appendages pink, but those colours are not preserved in the specimens which I have seen.

Habitat.—The Challenger collection includes two specimens, a male and a female, from 8 fathoms at Station 186, near Cape York, lat. 10° 30′ S., long. 142° 18′ E. Miers records it from Torres Straits and from other points in Northern Australia, as well as from the Red Sea, Ceylon, Gulf of Suez, Seychelles, Samoa Islands, Amboina, and other localities in the Indo-Pacific region.

Size.—Largest male specimen, $2\frac{14}{100}$ inches from tip of rostrum to middle of telson.

Gonodactylus glabrous, n. sp. (Pl. XIV. fig. 5; Pl. XV. figs. 7, 9).

Diagnosis.—Dactylus of raptorial claw without teeth, and dilated at base. Rostrum with a long slender acute median spine, and subacute lateral angles. Hind body wider than the carapace, with its sides straight and parallel. Second thoracic somite slightly exposed dorsally. Lateral edges of all the abdominal somites with triangular marginal carinæ with the apices directed backwards. Dorsal surfaces of the thoracic and first five abdominal somites without carinæ or spines. Sixth abdominal somite without a median carina, and with three pairs of lateral carinæ, all ending in spines, the submedian and intermediate being swollen and convex, while the marginal is more narrow and linear. The second or intermediate is shorter than the first and third. Telson ending in six acute spines with broad bases, and each with a sharply defined narrow longitudinal dorsal carina. Middle of dorsal surface of telson with a protuberant hemispherical eminence, upon which are five narrow sharply defined carinæ, of which the median and the two submedian end posteriorly in spines, while the marginal ones are without spines and shorter than the others. There is a triangular subacute prominence on the anterior edge of the dorsal surface of the telson on each side, halfway between the middle line and the lateral margin, with a narrow sharply defined carina. Paddles of exopodites of uropods less than half as long as the second joint. The basal joint of the uropod has only one acute spine on its dorsal surface, while its ventral prolongation ends in two nearly equal spines, with an obsolete rounded tooth on the inner margin of the outer one near its base. The tergal surfaces of the abdominal somites have no transverse or longitudinal sutures.

General Description.—This species is so very similar to *Gonodactylus graphurus* in every prominent characteristic that the description of that species will serve for this also,

except as regards the following features. The median spine of the rostrum of *Gonodactylus glabrous* reaches halfway to the tips of the eyes (see fig. 7). The carapace almost completely covers the fifth thoracic somite. The transverse cervical suture crosses the middle line of the carapace close to its posterior edge. The postero-lateral angles of the third and fourth as well as the fifth abdominal somite rectangular. The sixth abdominal somite has no median carina. The marginal carinæ of this somite are not swollen, and the intermediate and submedian carinæ are much less swollen than they are in *Gonodactylus graphurus*, especially towards their posterior ends (compare fig. 5 of Pl. XIV. with fig. 4). The abdominal somites have no transverse or longitudinal sutures. The telson is nearly $(\frac{14}{15}\frac{6}{1})$ as long as wide, and its various dorsal carinæ are all of them more sharply defined than they are in *Gonodactylus graphurus*, as will be seen by comparing fig. 5 with fig. 4, and they are very little or not at all swollen, so that the exposed spaces on the dorsal surface of the telson, between the carinæ on the median elevation as well as those between the carinæ on the lateral portions of the telson, are much wider than the carinæ themselves. The outlines of the bases of the marginal spines of the telson are nearly straight, and they lack the swelling convex curves of the graceful outline of the telson of *Gonodactylus graphurus*. The dorsal surface of the basal joint of the uropod has only one acute spine, and the paddle of the exopodite is considerably less than half $(\frac{1}{2}\frac{2}{3})$ as long as the second joint, when measured on the dorsal surface. The tip of the second joint of the first antenna is exposed in front of the eye. In all other respects the species conforms to the general description of *Gonodactylus graphurus*.

Locality.—The Challenger collection contains one female specimen from Samboangan Reefs.

Size.—The total length from the tip of the rostrum to the middle point of the posterior edge of the telson is $2\frac{5}{10\,0}$ inches.

Colour.—In the alcoholic specimen there is much less pigment than there is in *Gonodactylus graphurus*, and this is restricted to small sharply-defined symmetrical eye-like black spots, of which there are six in the cardiac area of the carapace, two on the sixth, and two on the seventh thoracic somite, four on the eighth, and six on each of the first five abdominal somites.

Remarks.—This species may be recognised by its very close and striking resemblance to *Gonodactylus graphurus*, from which it may be distinguished without difficulty by the absence of sutures on the abdominal terga, by the absence of a median dorsal carina on the sixth abdominal somite, as well as by the fact that all the dorsal carinæ on this somite and on the telson are more sharply defined and less swollen and rounded than they are in this species.

While it is a little closer than *Gonodactylus graphurus* to *Gonodactylus chiragra*, there is little difficulty in distinguishing it from the latter species by the presence of six well-developed marginal spines upon the telson, and of four carinæ upon the central

Measurements.	In inches and decimals.	In thousandths of total length.
Total length of female specimen from Samboangan Reefs,	2·05	
Measurements on middle line :—		
Rostrum,	·17	83
Carapace,	·51	249
Carapace, including rostrum,	·68	332
From posterior edge of carapace to posterior edge of third thoracic somite,	·10	49
From posterior edge of third to posterior edge of fourth thoracic somite,	·10	49
From posterior edge of fourth to posterior edge of fifth thoracic somite,	·10	49
First abdominal somite,	·12	59
Second abdominal somite,	·13	63
Third abdominal somite,	·13	63
Fourth abdominal somite,	·13	63
Fifth abdominal somite,	·18	88
Sixth abdominal somite,	·16	78
Telson on middle line,	·22	107
Total length of hind body,	1·37	668
Total length on middle line,	2·05	1000
Greatest length of telson,	·30	146
Width of rostrum,	·15	73
Width of carapace at antero-lateral angles,	·25	122
Width of carapace (greatest),	·35	171
Width of third thoracic somite,	·39	190
Width of fourth thoracic somite,	·39	190
Width of fifth thoracic somite,	·39	190
Width of first abdominal somite,	·39	190
Width of second abdominal somite,	·39	190
Width of third abdominal somite,	·39	190
Width of fourth abdominal somite,	·39	190
Width of fifth abdominal somite,	·39	190
Width of sixth abdominal somite between postero-lateral spines,	·32	156
Width of telson between submedian spines,	·08	39
Width of telson between intermediate spines,	·22	107
Width of telson (greatest),	·31	151
Length of paddle of exopodite of uropod on dorsal surface,	·12	58
Length of second joint of exopodite of uropod on dorsal surface,	·28	137

prominence, which is more protuberant both in *Gonodactylus glabrous* and in *Gonodactylus graphurus* than it is in *Gonodactylus chiragra*.

The very close resemblance between the three species shows their close relationship, and it is quite possible that future discoveries may reveal so many transitional forms that the sharp lines between the species will break down, but in the present state of our knowledge of the group I think we are compelled to recognise the three as distinct species.

Genus *Protosquilla*, n. gen. (Pl. XVI.).

Diagnosis.—Small Stomatopoda with the sixth abdominal somite more or less completely fused with the telson; the rostrum furnished with long acute median and antero-lateral spines; the dactylus of the raptorial claw dilated at the base, and without marginal spines, the eyes, antennary scales, and uropods small, and the hind body convex. Ontogeny unknown.

General Description and Remarks.—The following small but very interesting and remarkable Stomatopoda are very slightly known, and most of the species have, on account of the absence of spines on the dilated dactylus of the raptorial claw, been placed by various authors in Latreille's genus *Gonodactylus*, although they resemble each other in many features which are also points of difference from *Gonodactylus* as well as from all other Stomatopoda.

While it is also true that they differ greatly among themselves, it is not difficult to discover a common type of structure which runs through them all, and which should find its expression in our system of classification. I therefore place them in a distinct genus, and as many of their distinctive characteristics, such as the small size of their antennary scales and uropods, the great length of the acutely pointed rostrum, and the union of the sixth abdominal somite with the telson, are points of resemblance to the Stomatopod larva, I propose for the genus the name *Protosquilla*. This name is the more appropriate inasmuch as all the other Stomatopoda present evidences of divergent descent from a common stem form, which, like the living representatives of the genus *Protosquilla*, was characterised by the small size of its eyes, antennary scales, and uropods. In this genus the dactylus of the raptorial claw is dilated at the base, with microscopic serrations, but no spines, on its inner margin; the rostrum has a long slender acute median spine, and one or more pairs of acute antero-lateral spines; the eyes are small and subcylindrical; the carapace is smooth and flat, with well-marked longitudinal sutures, but with the transverse cervical suture obsolete; the hind body is convex, without dorsal carinæ on the first four terga, with its posterior end curved downwards, and with the sixth abdominal somite more or less completely fused with the telson. The telson and sixth abdominal somite differ in texture from the general surface of the body, and are often remarkably and elegantly ornamented; the telson is usually wider than long, and its marginal spines are pushed backwards, and are either obsolete or else developed in a remarkable manner. The eyes, antennary scales, and uropods are very small, and the prolongation from the ventral surface of the basal joint of the uropod ends in two short stout spines.

All but three of the following species are known to exhibit all of these characteristics, and while the published accounts of those three are so incomplete as to leave many points in uncertainty, the close general resemblance between them and the better known species indicates that future research will show that they share all the characteristics of the genus.

As regards one of the most remarkable peculiarities of the genus, the pushing backwards of the marginal spines of the telson, the various species present a most interesting series of steps in the process of modification. In *Protosquilla folinii*[1] the outline of the telson closely approximates the prevalent type among the Stomatopoda. There are six marginal spines, and the submedians, which project furthest backwards, are separated by a well-marked median notch, while the second pair are a little more anterior, and the third pair still more so, all the marginal spines, however, being further back than they are in ordinary Stomatopods. In the very closely related species, *Protosquilla elongata*, Pl. XV. fig. 2, all the spines are fused into a pair of rounded lobes on the sides of the median notch, and no traces of the separate spines are visible in a dorsal view, although their rounded ends project slightly below the general surface of the ventral side of the telson, as shown in fig. 12.

In *Protosquilla trispinosa* (*Gonodactylus trispinosus*, Miers, Squillidæ, pl. iii. fig. 10) the median notch is faintly indicated, and all the spines are on the convexly rounded posterior border of the telson. In *Protosquilla cerebralis* (Pl. XVI. fig. 2) the telson is transversely truncated behind, and the spines are all on its posterior edge. In *Protosquilla excavata* (*Gonodactylus excavatus*, Miers, Squillidæ, pl. iii. fig. 12) the spines are obscurely indicated, but the lateral ones are now the longest, and the edge of the telson is deeply excavated between them, while in *Protosquilla furcicaudata* (*Gonodactylus furcicaudatus*, Miers, Squillidæ, pl. iii. fig. 14) this excavation is carried so far that the median portion of the telson has disappeared, and the two marginal spines have approached each other on the middle line, evidently as the result of an infolding of the median portion of the posterior edge of the telson of the larva. In *Protosquilla guerinii* (Pl. XVI. fig. 1), the marginal spines have undergone a very remarkable modification in a somewhat divergent direction. They are on the posterior edge, and the laterals project as far backwards as the submedians, but they have become greatly divided, forming a complicated pectinated structure.

As regards the telson, *Protosquilla folinii* is at one end of a series at the other end of which is *Protosquilla furcicaudata*, but it is difficult to decide which of these forms is the one in which the process of modification began. As the telson is long, with a convex border, in most Malacostraca, and in the Stomatopod larva, it is probable that *Protosquilla folinii* is the primitive form, and *Protosquilla furcicaudata* a highly modified form, and that the relationship to the other Stomatopoda is through *Protosquilla folinii*, which must therefore be regarded as one of the closest living allies of the ancestral type of the order.

Outside the genus *Protosquilla;* the two species for which I have proposed to establish the genus *Coronida*, *Coronida bradyi* and *Coronida trachura*, are very similar to *Protosquilla*, as are also, but in a less degree, the true *Gonodactyli*. On account of the

[1] *Gonodactylus folinii*, A. Milne-Edwards, *Nouv. Arch. Mus. Hist. Nat.*, t. iv., pl. xviii. fig. 10.

great interest of this genus, I give, in addition to the descriptions of the species which are represented in the Challenger collection, brief diagnoses of the other known species.

1. *Protosquilla elongata*, n. sp. (Pl. XV. figs. 2, 12; Pl. XVI. fig. 4).

Diagnosis.—*Protosquilla* with the median spine of the rostrum long and slender, and the antero-lateral spines bifurcated at the tips. Carapace elongated, two-thirds as wide as long, with antero-lateral angles acute. Second thoracic somite exposed and subacute laterally. Hind body wider than carapace. Lateral angles of third, fourth, and fifth thoracic somites nearly straight, with rounded angles. Sixth abdominal somite with a thickened transverse ridge along its posterior border, from which four thickened carinæ, two submedian and two submarginal, run forwards to the anterior edge of the somite, the two outer carinæ being obscurely divided into three lobes. Suture between sixth abdominal somite and telson distinct but immovable.

Telson a little wider than long, with a thickened median carina, and on each side of this a very wide and prominent curved lateral carina. Telson with a deep notch on the middle line behind, and on each side of this an obtusely rounded lobe, the outline of which is continuous in a dorsal view, but with traces of three marginal spines on the ventral surface. Endopodite of uropod triangular. First antennæ short. An acute spine on anterior edge of first joint of second antenna.

General Description.—Median spine of rostrum slender and acute, slightly dilated at base, and reaching nearly to the tips of the eyes, which are cylindrical, with the corneal portion inclined backwards externally. Antero-lateral angles of rostrum long, acute, curved forwards, and divided at the tip into two spines one above the other. Carapace narrower than hind body, much longer ($\frac{2}{1}\frac{3}{5}$) than wide, and slightly emarginated. The antero-lateral angles ending in short spines, the postero-lateral angles rounded. Gastric area distinct, rectangular, slightly convex, with gastric suture continued nearly straight to posterior edge. Second thoracic somite exposed, narrow, and subacute at lateral edges. The following thoracic somites wider than the carapace and nearly as wide as the hind body. The lateral edge of the third is longitudinally truncated, that of the fourth obliquely truncated, so that the somite is wider at the antero-lateral than at the postero-lateral angle. The fifth is produced into a subacute lobe. First five abdominal somites smooth dorsally, and almost but not quite equal in width; the width of the first being $\frac{162}{1000}$, and that of the fifth $\frac{184}{1000}$, of the total length. The postero-lateral angles of the abdominal somites are subacute. The sixth abdominal somite is immovably united to the telson, but the suture is distinct. The posterior edge of the dorsal surface is elevated into a thick, obscurely defined, rounded transverse ridge, from which

four thickened carinæ run forwards nearly to the anterior edge of the somite, separated from each other by interspaces which are about equal to the ridges in width.

The two submedian carinæ are nearly parallel and longitudinal, while the two outer or submarginal ones diverge anteriorly, and have their inner edge obscurely divided into three rounded lobes. The telson is deeply notched on the middle line, and is slightly wider than long. In a ventral view (Pl. XV. fig. 12) each of the rounded lobes which borders the median notch is seen to consist of three marginal spines, crowded backwards, but with the submedian longest, the intermediate shorter, and the external shortest. No trace of these spines is visible in a dorsal view, and the dorsal outline of the telson consists of a single obtusely rounded lobe on each side of the triangular median notch, which is fringed with hairs.

The middle of the dorsal surface of the telson is occupied by a broad wedge-shaped median ridge or carina, which is wide anteriorly and narrows posteriorly to a rounded point which is scarcely elongated above the general surface of the telson. This carina is surrounded on all sides, except at its anterior end, by a depression or groove, outside which there is on each side a greatly thickened submedian carina or ridge, the general course of which is longitudinal, although it is slightly curved, with the convexity away from the middle line.

The tips of the extended uropods reach nearly as far backwards as the telson. The paddle of the exopodite is very small, that of the endopodite longer and nearly triangular. The basal joint has a single acute spine on its dorsal surface, and the two ventral spines are short and stout, the outer being the larger and longer.

The eyes are cylindrical, with the convex curved portion obliquely placed and running backwards on the outside of the base. The ocular segment is exposed, broad, and deeply notched on the middle line under the median spine of the rostrum. The antennæ are short, and the basal joint of the second ends in an acute spine. The dactylus of the raptorial claw is greatly swollen at the base, with a deep notch on its outer edge. The tip of the dactylus is gently and regularly curved to the acute point, and its inner edge is barbed with minute serrations, nearly to the base. The edge of the second joint is bordered by minute dentations.

The exposed thoracic legs are long and slender.

The dorsal surface of the body, with the exception of the sixth abdominal somite and telson and uropod, is highly polished, while these are rough.

Habitat.—One female specimen from St. Vincent, Cape Verde Islands.

Colour.—In the alcoholic specimen the telson and sixth abdominal somite and uropods are dirty-white, while the rest of the body is highly polished and very dark brown, except a transverse strip of light yellowish-brown across the carapace, posterior to the middle point of its length, and a corresponding light band across the enlarged joint of the second maxilliped.

Measurements.	In inches and decimals.	In thousandths of total length.
On middle line :—		
Rostrum,	·07	91
Carapace,	·17	221
Carapace, including rostrum,	·24	312
From posterior edge of carapace to posterior edge of third thoracic somite,	·042	55
From posterior edge of third to posterior edge of fourth thoracic somite,	·043	56
From posterior edge of fourth to posterior edge of fifth thoracic somite,	·042	55
First abdominal somite,	·043	56
Second abdominal somite,	·043	56
Third abdominal somite,	·052	68
Fourth abdominal somite,	·060	78
Fifth abdominal somite,	·073	95
Sixth abdominal somite,	·057	74
Telson on middle line,	·072	94
Length of hind body,	·527	687
Total length on middle line,	·767	999
Greatest length of telson,	·10	130
Width of carapace between antero-lateral spines,	·092	120
Width of carapace (greatest),	·115	149
Width of third thoracic somite,	·128	165
Width of first abdominal somite,	·125	163
Width of fifth abdominal somite,	·141	184

Size.—Length, $\frac{77}{100}$ inch.

Remarks.—A comparison of this species with the descriptions of *Gonodactylus folinii* which are given by A. Milne-Edwards[1] and Miers[2] would at first sight seem to indicate that they are the same as this species, as there is a very close general resemblance, as well as an almost perfect agreement in size, and Milne-Edwards' single specimen was obtained at St. Vincent, the place where the Challenger specimen was collected. Neither of these authors notices the bifurcation of the antero-lateral spines of the rostrum, the elongation of the carapace or the spines at its antero-lateral angles, but as these points might easily have been overlooked on account of the great minuteness of the specimens, I was at first inclined to believe that they are the same, but careful examination of Milne-Edwards' figures brings out so many important points of difference that I am forced to conclude that there are at St. Vincent two closely related species of this minute type, or else that the figures which are given by Milne-Edwards are so inaccurate as to be of no value. Which of these alternatives is the true one can be decided only by renewed examination, and as our specimen differs very essentially from

[1] *Nouv. Arch. Mus. Hist. Nat.*, t. iv. p. 65.

[2] *Ann. and Mag. Nat. Hist.*, ser. 5, vol. v. p. 123.

Milne-Edwards' figures of *Gonodactylus folinii*, and as it also fails to agree perfectly with his and Miers' descriptions, it must for the present at least be regarded as a distinct species, differing from *Protosquilla* (*Gonodactylus*) *folinii* in the following points:—Antero-lateral angles of rostrum simple in *Protosquilla folinii*, double in *Protosquilla elongata*. Posterior margin of telson with three rounded spines on each side of the deep median notch in *Protosquilla* (*Gonodactylus*) *folinii*, and a single obtusely rounded lobe in *Protosquilla elongata*.

If A. Milne-Edwards' figures are trustworthy the two species also differ in the following features:—First antennæ very long in *Protosquilla folinii*, short in *Protosquilla elongata*. No spine on anterior edge of basal joint of second antenna in *Protosquilla folinii*, a long spine in *Protosquilla elongata*. Carapace nearly as wide as long, rectangular, and with rounded antero- and postero-lateral angles in *Protosquilla folinii*; elongated, emarginated, narrow anteriorly, and with antero-lateral angles acute in *Protosquilla elongata*. Thoracic and abdominal somites rounded in *Protosquilla folinii*; lateral margins of thoracic somites of *Protosquilla elongata* truncated, and postero-lateral angles of abdominal somites acute.

The species is of great interest as it and the closely related *Protosquilla folinii* are the most primitive forms which are known among the Stomatopods, exhibiting the embryonic or larval features which are characteristic of the genus, such as the fusion of the telson with the sixth abdominal somite, the small size of the uropods, and the presence of three long spines on the rostrum; without exhibiting any of the remarkable modifications of the posterior end of the body which are so strikingly characteristic of most of the species of the genus. The telson of an ordinary *Squilla*, that of *Coronis*, or that of the most aberrant *Protosquilla*, such as *Protosquilla guerinii*, may all be derived from that of *Protosquilla folinii* by very slight changes, and the carapace of *Protosquilla elongata* might be readily modified into that of a true *Squilla*, while it is also very similar to the flat square carapace of the other members of its own genus.

2. *Protosquilla folinii* (Milne-Edwards).

Gonodactylus folinii, A. Milne-Edwards, Obs. sur la Fauna Carcinol. des Iles du Cap-Vert, Nouv. Arch. Mus. Hist. Nat., t. iv. 1868, p. 65, pl. xviii. figs. 8–11.

Gonodactylus Folinii, Miers, E. J., On the Squillidæ, Ann. and Mag. Nat. Hist., ser. 5, vol. v., 1880, p. 123.

Diagnosis.—Protosquilla with the rostrum ending in a long slender acute median spine, and on each side of this a single acute antero-lateral spine which is directed outwards and forwards and is a little shorter than the median spine. Carapace with rounded antero- and postero-lateral angles. First five abdominal somites smooth, Dorsal surface of sixth abdominal somite with four rounded tubercles, the outer ones

three-lobed. Dorsal surface of telson with a broad unarmed median ridge, and on each side of this a more protuberant longitudinal and somewhat uniform prominence, which is convex on its lateral or external side, and concave towards the middle line. The telson has a median notch on its posterior edge, and on each side of this there are three obtuse rounded marginal spines, of which the submedian is farthest back, and the lateral most anterior.

Length.—About three-fourths of an inch.

Habitat.—A. Milne-Edwards records a single specimen of this species from St. Vincent, and Miers a single male from Mauritius, and two small specimens, without record of locality, from the "Herald" collection.

Remarks.—In Milne-Edwards' figures the carapace is represented rounded at its anterior as well as at its posterior angles, and nearly rectangular, and the fifth thoracic somite is represented with rounded lateral edges, as are all the other thoracic and abdominal somites.

In my remarks on *Protosquilla elongata* I have given my reasons for regarding that species as distinct from this one.

3. *Protosquilla trispinosa* (White).

Gonodactylus trispinosus, White, List Crust. Brit. Mus., 1847, p. 85.
Gonodactylus trispinosus, Dana, J. D., U.S. Explor. Exped., Crustacea, i. p. 623, 1852.
Gonodactylus trispinosus, Heller, C., Reise der Novara, 1868, Crustacea, p. 126.
Gonodactylus trispinosus, Miers, E. J., Cat. New Zealand Crust., 1876, p. 126.
Gonodactylus trispinosus, Miers, E. J., On the Squillidæ, Ann. and Mag. Nat. Hist., ser. 5, vol. v., 1880, p. 121, pl. iii. fig. 10 (telson).
Gonodactylus trispinosus, Miers, E. J., Malaysian Crustacea, Ann. and Mag. Nat. Hist., ser. 5, vol. v. p. 460.

Diagnosis.—*Protosquilla* with the two antero-lateral spines of the rostrum nearly as long as the median spine. The carapace is long, and nearly rectangular, with nearly rectangular antero- and postero-lateral angles. The fifth abdominal somite is longitudinally corrugated. The sixth is immovably united to the telson, although the suture is clearly indicated; its dorsal surface is marked by six smooth rounded tubercles. On the dorsal surface of the telson there are three smooth rounded tubercles disposed in a triangle, with the median one anterior to the two laterals. The posterior margin is slightly notched in the middle, and is armed with very minute spines.

Size.—About one and one half inches long.

Habitat.—Fiji Islands, Dana; Auckland, Heller; Mauritius, ? Hoffmann; Swan River, Australia, Miers; Shark's Bay, Australia, Miers; Amboina, Miers; Ceylon, Miers (var. *pulchella*).

Remarks.—According to Heller's description the telson is rectangular and is armed

with four marginal spines, while Miers represents it as broadly rounded posteriorly and armed with six minute marginal spines. It therefore seems possible that there may be two closely related forms instead of a single species.

Although this species is much better known than any other *Protosquilla* no figure has ever been published except the drawing of the telson given by Miers. A minutely accurate figure of the entire animal is very much needed. All the specimens the sex of which is given are males, except the single female recorded by Miers from Amboina.

4. *Protosquilla cerebralis*, n. sp. (Pl. XIV. figs. 2, 3; Pl. XVI. figs. 2, 3).

Diagnosis.—*Protosquilla* with the body almost uniform in width from the anterior edge of the carapace to the posterior edge of the telson. The two slender acute antero-lateral spines of the rostrum are nearly as long as the acute median spine. The carapace is rectangular, with rounded angles, and the fifth thoracic somite is slightly exposed dorsally. No dorsal carinæ on the carapace or on the first seven exposed somites. Lateral processes of the sixth and seventh thoracic somites longer than those of the eighth, and rounded. Postero-lateral angles of all the abdominal somites obtuse. Dorsal surface of fifth abdominal somite with a median thickened carina, and, on each side of this numerous sublongitudinal ridges, converging posteriorly. Sixth abdominal somite immovably fused with the telson and ornamented by swollen convoluted ridges symmetrically arranged in a complex pattern. Telson nearly twice as wide as long, deeply notched on the middle line behind, with its posterior margin rounded and ending in three pairs of short acute spines. Dorsal surface of the telson sculptured in a complicated symmetrical convoluted pattern, consisting of a very complex central pattern which is subtriangular and divided into five principal convolutions; two submedian convex oval convoluted lobes, and a number of parallel longitudinal lateral ridges. Dactylus of raptorial claw greatly swollen at base.

General Description.—The median spine of the rostrum is slender, acute, longer than the antero-lateral spines, and reaching about halfway to the tips of the eyes, which are subcylindrical, with the corneal portion inclined backwards externally. The antero-lateral spines of the rostrum are slender and acute. The flat carapace is a little longer than wide, slightly narrower than the exposed thoracic somites, and nearly rectangular with the antero- and postero-lateral angles, rounded and nearly alike. The two longitudinal sutures are prominent and continuous from the anterior to the transverse posterior edge, and there is a faintly marked transverse cervical suture. The sixth and seventh thoracic somites are wider than the eighth, and their lateral edges are produced backwards and rounded, as seen from above, while in profile the anterior angle is obtuse and the posterior one nearly a right angle. The middle of the lateral edge of the eighth is produced into a subacute lobe over the basal joint of the appendage. The eighth is a

little longer and narrower than the sixth and seventh thoracic somites, and a little shorter than the first four abdominal somites, which are about equal in length, as wide as the sixth and seventh thoracic, smooth on the dorsal surfaces, and with marginal keels or ridges on their lateral edges, the postero-lateral angles of which are nearly right angles. The fifth abdominal somite is longer than, and quite different from, those in front of it, as its dorsal surface is sculptured by numerous sublongitudinal ridges symmetrically arranged on each side of a broad median ridge or carina. The ridges are not quite as long as the somite, which has along its anterior and posterior borders smooth bands which are not broken into ridges. The lateral ridges are slightly convergent towards the posterior edge, and their anterior ends are lobed and sometimes irregularly forked. The sixth abdominal somite is shorter on the middle line than at the edges and immovably fused with the telson which is transverse, and nearly twice as wide as long. The posterior end of the body is bent downwards, so that the dorsal surface of the telson faces backwards. The sixth abdominal somite is sculptured in a symmetrical pattern of broad convoluted ridges and tubercles, which are so closely crowded together that the dorsal surface is almost covered with them. The dorsal surface of the telson is also sculptured in a complicated pattern, in which six elements may be recognised, first, a transverse ridge lobed on its posterior edge running along the anterior border of the telson; second, a triangular median area, the broad anterior end of which is elevated above the general surface of the telson, while its narrow posterior portion is sunk between two lateral elevations. The median area is convoluted and divided into five lobes, a median anterior, two antero-laterals which are again subdivided, and two posterior lobes or ridges, one of which runs backwards on each side of the deep narrow postero-median notch; third, on each side of the median area an elongated oval elevated area, which is divided into halves by a longitudinal furrow, and also divided by lateral furrows into a number of secondary lobes; fourth, three thickened longitudinal marginal keels on each side external to the oval elevation. The six short acute marginal spines are crowded together in two sets, on the posterior edge of the telson, with a broad space fringed with small spines between the submedians.

The uropods are small, and the basal prolongation (Pl. XVI. fig 3) ends in two short stout acute spines, the outer larger and longer than the inner, and with a slight enlargement on its inner edge. The row of marginal spines, about ten in number, on the outer edge of the second joint of the exopodite curves upwards on to the dorsal surface at its proximal end. The inner edge of the dactylus (Pl. XIV. fig. 3) of the raptorial claw is finely serrated, and the basal enlargement on the outer edge is semi-circular, abruptly limited distally, and indented on its outer margin.

Size.—The length of the single specimen is $1\frac{27}{100}$ inches from the tip of the rostrum to the middle line of the telson.

Habitat.—The single female specimen is from the reefs at Levuka, Fiji.

Measurements.	In inches and decimals.	In thousandths of total length.
Total length from tip of rostrum to tip of telson on middle line,	1·27	
Rostrum,	·08	62
Carapace,	·30	234
Carapace including rostrum,	·38	296
From posterior edge of carapace to posterior edge of third thoracic somite,	·05	39
From posterior edge of third to posterior edge of fourth thoracic somite,	·06	47
From posterior edge of fourth to posterior edge of fifth thoracic somite,	·08	62
First abdominal somite,	·10	78
Second abdominal somite,	·09	70
Third abdominal somite,	·09	70
Fourth abdominal somite,	·12	93
Fifth abdominal somite,	·13	101
Sixth abdominal somite,	·07	55
Telson on middle line,	·10	78
Total length of hind body,	·89	673
Total length on middle line,	1·27	969
Greatest length of telson,	·14	109
Width of carapace between antero-lateral angles,	·18	140
Width of carapace (greatest),	·23	179
Width of third thoracic somite,	·25	195
Width of fourth thoracic somite,	·26	199
Width of fifth thoracic somite,	·24	187
Width of first abdominal somite,	·27	210
Width of second abdominal somite,	·27	210
Width of third abdominal somite,	·27	210
Width of fourth abdominal somite,	·27	210
Width of fifth abdominal somite,	·27	210
Width of sixth abdominal somite,	·26	199
Width of telson between postero-median spines,	·08	62
Width of telson (greatest),	·26	199
Length of paddle of exopodite of sixth abdominal appendage,	·06	47
Length of second joint of exopodite of sixth abdominal appendage,	·10	78
Length of endopodite of exopodite of sixth abdominal appendage,	·10	78
Distance between tips of sixth abdominal appendage,	·57	444
Length of first antenna, measured from tip of rostrum,	·35	273
Length of flagellum of second antenna,	·20	156
Length of scale of second antenna,	·13	101
Length of eye,	·09	70

Colour.—The fifth and sixth abdominal somites and the telson and uropods of the alcoholic specimen are colourless and rough, while the rest of the body is highly polished, and mottled with brown pigment.

Remarks.—The only species which is at all similar to this is Wood-Mason's *Gonodactylus glyptocercus* from the Nicobars, but his description, which is given below, is so

brief and imperfect that it is impossible to decide how closely related these two are. They may be the same species, but so far as the description shows, it is quite possible that the resemblance is a superficial one only, and that they are not at all similar in their essential characteristics.

5. *Protosquilla glyptocerca* (Wood-Mason).

Gonodactylus glyptocercus, Wood-Mason, Proc. Asiatic Soc. Bengal, p. 232, 1875.
Gonodactylus glyptocercus, Wood-Mason, Ann. and Mag. Nat. Hist., ser. 4, vol. xvii. p. 263, 1876.
Gonodactylus glyptocercus, Miers, E. J., On the Squillidæ, Ann. and Mag. Nat. Hist., ser. 5, vol. v. p. 123, 1880.

In his description of this species, which is very brief, he does not say whether the sixth abdominal somite is fused with the telson. It is possible that it is not related in any way to the species of *Protosquilla*, but I place it here provisionally as the only points he mentions show a striking likeness to *Protosquilla cerebralis*, with which it may possibly be identical.

His short notice simply says that it is like *Gonodactylus trispinosus*, but that the terminal post-abdominal somite is ornamented with two oval tubercles, bounded by an impressed inverted line, and with a medium cinquefoil-shaped one, and the two preceding segments symmetrically engraved with fine lines.

6. *Protosquilla guérinii* (White) (Pl. XVI. figs. 1 and 6.)

Gonodactylus guérinii, White, A., New Crustacea, Proc. Zool. Soc. Lond., January 22, 1861, p. 43, pl. vii.
Gonodactylus guérinii, White, A., Ann. and Mag. Nat. Hist., vol. vii., 1861, p. 476.
Gonodactylus guérinii, Miers, E. J., On the Squillidæ, Ann. and Mag. Nat. Hist., ser. 5, vol. v., 1880, p. 121.

Diagnosis.—Protosquilla with eyes slightly enlarged at tips, carapace as wide as long. Second thoracic somite exposed. First five abdominal somites with marginal carinæ. Fifth abdominal somite with several transverse rows of short acute dorsal spines on its posterior half. Sixth abdominal somite covered on its dorsal surface with numerous long spines. Posterior edge of telson with two pairs of marginal spines projecting backwards. The submedian with a single row of secondary spines on each side, and the laterals with a single row on the inner and a double row on the outer edge, running from its tip along the outer edge of the telson to its anterior end. Dorsal surface of telson with twenty-two long spines symmetrically arranged. Second joint of exopodite of uropod nearly three times as long as paddle. Dilated base of dactylus of raptorial claw truncated on its outer edge, and not notched. Endopodite of uropod with five spines on its dorsal surface.

General Description.—The Challenger collection contains one female specimen from Honolulu of this species, which has previously been represented by the single specimen which was obtained by the "Herald" from Matuku, Fiji Islands. It may be distinguished without difficulty from all other known Stomatopods, except A. Milne-Edward's *Squilla bradyi*, by the long spines which cover the telson and sixth abdominal segment, and from this species by the length of the median spine of the rostrum, and the absence of spines on the inner edge of the dactyle of the raptorial claw.

Transverse diameter of rostrum about equal to its length; antero-lateral spines of rostrum acute, but very slightly produced forwards, and shorter than the median spine, which ends in an acute point opposite the middle of the eye. The carapace is nearly square, as long as wide, slightly narrowed anteriorly, and with antero- and postero-lateral angles rounded and alike. The gastric area is slightly convex and its lateral sutures are sharply defined, while the transverse cervical suture is almost obsolete. Carapace wider than thoracic region, and about as wide as the abdomen. First thoracic somite exposed and subacute at lateral edges. Third, fourth, and fifth thoracic somites so articulated as to form a convex dorsal protuberance. Lateral edges of third and fourth obliquely truncated converging posteriorly, with rounded angles. Lateral edges of fifth subacute. The abdomen increases slightly in width from in front backwards, but not so rapidly as in White's figure. The abdominal somites have faintly marked marginal carinæ or ridges, and the first four have on each side, at about one-third of the distance from the lateral edge to the middle line, a small sharply defined indentation. The sixth abdominal somite is immovably united to the fifth as well as to the telson, although the sutures are distinctly visible. The first four abdominal somites are smooth dorsally, as is also the anterior half of the fifth, a transverse line separating it from the posterior half, which is armed by about six transverse rows of numerous short spines, which increase in length and in the definiteness of the transverse rows as they approach the posterior margin of the somite. The dorsal surface of the sixth abdominal somite is armed with very numerous (about fifty-six) long cylindrical spines, each of which ends in a blunt rounded tip with a perforation from which a soft tubular fleshy process protrudes. Eight of these spines are arranged in a transverse line along the posterior border of the somite, and are arranged symmetrically in pairs with reference to the middle line, about twenty more form an anterior transverse band which, starting at the postero-lateral angle, runs obliquely forwards to the anterior edge of the somite, along which it is continued across the middle line. The triangular antero-lateral area, external to this line, is occupied by about fourteen crowded spines on each side.

The suture between this somite and the telson is distinct, but immovable, and bordered by a raised ridge.

The central area of the telson is occupied by twenty-two similar long spines, with fleshy appendages, symmetrically arranged with reference to the middle line, and so

Measurements.	In inches and decimals.	In thousandths of total length.
On middle line.		
Rostrum,	·07	62
Carapace,	·23	205
Carapace including rostrum,	·30	267
From posterior edge of carapace to posterior edge of third thoracic somite,	·05	45
From posterior edge of third to posterior edge of fourth thoracic somite,	·07	62
From posterior edge of fourth to posterior edge of fifth thoracic somite,	·09	81
First abdominal somite,	·07	62
Second abdominal somite,	·08	72
Third abdominal somite,	·07	62
Fourth abdominal somite,	·08	72
Fifth abdominal somite,	·11	98
Sixth abdominal somite,	·05	45
Telson on middle line,	·15	134
Total length of hind body,	·82	733
Total length on middle line,	1·12	1000
Telson to tips of spines,	·24	234
Width of carapace between antero-lateral spines,	·19	169
Width of carapace (greatest),	·24	234
Width of fourth thoracic somite,	·20	178
Width of first abdominal somite,	·21	187
Width of fifth abdominal somite,	·25	223
Width of telson between bars of lateral spines,	·28	249
Width of telson between tips of lateral spines,	·17	151

placed that they fall into rows longitudinally and transversely. Two are on the middle line, and the others in pairs. There are five in the first transverse row, six in the next, two in the third, five in the fourth, and four in the last. The free edge of the telson carries two pairs of primary marginal spines which are pushed back into the posterior border. The submedians are slightly longest, acute, separated by a deep median notch, and with twelve long acute secondary spines on their inner and nine on their outer edge. The two lateral spines are also acute, and have six acute long secondary spines on their inner edge, and on their outer edge very numerous (twenty-four or more) long spines placed in two rows, one above the other, and running along the outer edge of the telson to its anterior end.

The uropods are very short and small; the paddle of the endopodite is elongated oval with five acute immovable spines placed in a longitudinal row on its dorsal surface, the paddle of the exopodite is very small, the second joint long with eight movable spines on its outer edge. The spines on the basal prolongation are short and acute, and the inner one very much shorter and more slender than the outer one.

The basal enlargement on the dactyle of the raptorial claw is not notched, its outer border is truncated, and at its distal edge the transition is abrupt to the long slender gently curved acute tooth, which is barbed with minute serrations on its inner edge, while the outer edge of the second joint is finely dentate, with acute teeth.

The eyes are subcylindrical, with the coronal portion a little wider than the basis. No secondary differences between the sexes, except in the first abdominal somite.

Habitat.—The Challenger collection contains a single female specimen from Honolulu. The only other known specimen is a male from Matuku, Fiji Islands, described by White and also by Miers.

Colour.—White describes his dry specimen as "marbled," of a light yellowish-brown colour, varied with a darker colour. The Challenger specimen, preserved in alcohol, has a broad transverse light band across the carapace, while the rest of the dorsal surface is marked with brown pigment.

Length, $1\frac{12}{100}$ths inches.

7. *Protosquilla excavata* (Miers).

Gonodactylus excavatus, Miers, E. J., On the Squillidæ, Ann. and Mag. Nat. Hist., ser. 5, vol. v. p. 123, pl. iii. figs. 11, 12.

Diagnosis.—Antero-lateral angles of carapace subacute, antero-lateral angles of rostrum acute, slender, shorter than elongated median spine. Fifth abdominal somite smooth. Sixth with six irregular longitudinal prominences, separated by deep interspaces, and confluent distally. Telson deeply excavated posteriorly, and with five prominent smooth longitudinal obtuse keels, the submedians longest and reaching to the postero-lateral lobe. First antennæ very long.

Length, $\frac{3}{4}$th inch.

Locality.—Miers describes this species from a single male specimen of unknown origin.

Remarks.—The published description does not state that the sixth abdominal somite is fused with the telson.

8. (?) *Protosquilla furcicaudata* (Miers).

Gonodactylus furcicaudatus, Miers, E. J., On the Squillidæ, Ann. and Mag. Nat. Hist., ser. 5, vol. v., 1880, p. 124, pl. iii. figs. 13–16.

Although Miers does not state whether the sixth abdominal somite of this species is fused with the telson, it exhibits so many features of resemblance to the *Protosquillæ* that I place it here provisionally. It may be briefly described as follows. Eyes, antennæ, rostrum, carapace, exposed thoracic somites, and first five abdominal somites as

in *Protosquilla*. The sixth abdominal somite narrow, with six longitudinal prominences. Telson very short and transverse, with two slender spines projecting backwards from its posterior margin, with their bases in contact on the middle line, and their tips slightly divergent.

Comparison with the other *Protosquillæ* indicates that the two long spines of this species are the external marginal spines of the telson, which have become approximated on the middle line by the disappearance of almost the whole of the posterior border of the telson.

Genus *Coronida*, n. gen.

The two following species *Gonodactylus bradyi* of A. Milne-Edwards, and *Gonodactylus trachurus*, Miers, resemble each other very closely and present many points of resemblance to the genus *Protosquilla*, but they are quite anomalous in other respects, since they present a most interesting and suggestive resemblance to *Squilla*, *Lysiosquilla* and *Gonodactylus*. Their features of resemblance to *Gonodactylus*, the enlargement of the base of the dactylus of the raptorial claw, the flat rectangular carapace, and the pointed rostrum, are at the same time features of resemblance to *Protosquilla*, and it seems probable that they are the living representatives of an ancestral type which was closely related on the one hand to *Protosquilla*, while on the other hand it was very similar to the common type of which *Lysiosquilla* and *Squilla* are the divergent descendants. As the most primitive species of the genus *Squilla* are often placed in a distinct genus *Chlorida*, while the lowest members of the genus *Lysiosquilla* are often placed in a distinct genus, *Coronis*, and as the features of resemblance to *Squilla* and *Lysiosquilla*, exhibited by the species now under discussion, point to a relationship with the lower rather than with the higher forms in these genera, I propose for them a generic name which shall express this fact, and the generic term *Coronida* is a compound of the first two syllables of *Coronis*, with the last two of *Chlorida*.

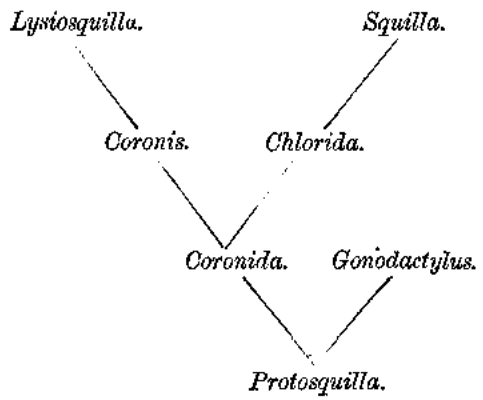
The two species of *Coronida* resemble *Protosquilla* in the minuteness of the antennary scales and uropods; in the fact that the anterior somites of the hind body are smooth, and conspicuously different from the sixth abdominal somite and telson, as well as in the presence of a median spine on the rostrum, and the enlargement of the base of the dactylus of the raptorial claw, and the shape of the carapace.

It is not stated that the sixth abdominal somite is fused with the telson, but the markings on the posterior end of the body are strikingly like those of *Protosquilla guerinii*, since Milne-Edwards describes this part of the body of *Coronida bradyi* in words which perfectly fit *Protosquilla guerinii*, as uniformly covered with numerous closely placed slender spines which are longest near the posterior margin, while Miers says that the posterior half of the fifth abdominal somite of *Coronida trachura* is

minutely spinulose on its posterior margin, a characteristic which is exactly duplicated in *Protosquilla guerinii*.

The two species differ from *Protosquilla* in the absence of antero-lateral spines on the rostrum, and the enlargement of the tips of the eyes, and from both *Protosquilla* and *Gonodactylus* in the presence of spines on the inner edge of the dactyle of the raptorial claw, and the depression of the hind body; resembling both *Squilla* and *Lysiosquilla* in these features.

The relationships of *Coronida* are therefore expressed in the accompanying diagram.



Diagnosis.—Hind body depressed, dactylus of raptorial claw dilated at base, and armed with spines on its inner edge. Rostrum ending in a small median spine. Antennary scales and uropods very small. Terminal segments of hind body and telson thickly set with small spines. Carapace flat and nearly rectangular.

Coronida bradyi (A. Milne-Edwards).

Gonodactylus bradyi, A. Milne-Edwards, Fonds de la Mer, vol. ix., 1869, p. 137, pl. xvii. fig. 11; Miers, E. J., On the Squillidæ, Ann. and Mag. Nat. Hist., ser. 5, vol. v., 1880, p. 117.
Gonodactylus bradyi, Miers, E. J., Crustacea from Mauritius, Proc. Zool. Soc. Lond., January 5, 1884, p. 16.

Coronida trachura.

Gonodactylus trachurus, Miers, E. J., Crustacea from Mauritius, Proc. Zool. Soc. Lond., January 5, 1884, p. 16.

The Alima Larva and the Metamorphosis of Squilla.

Although, as Claus has well shown in his classical monograph on the metamorphosis of the Stomatopoda,[1] the *Alima* larva is connected with the *Erichthus* larva by so many intermediate forms that it is difficult to draw an absolute line between them, it is nevertheless true that the *Alima* is more different from the *Erichthus* than any of the various modifications of the latter type are from each other, and in the description and discussion of the *Alima* larva which follows, I shall give my reasons for believing that all the *Alimæ* are the larvæ of adults which belong to the genus *Squilla*, and that all the species of this genus pass through an *Alima* stage, while all the other Stomatopods pass through their larval life as *Erichthi*. The *Alima* larva is undoubtedly a modified *Erichthus*, and some species deviate much more widely than others from the *Erichthus* type, but the group is on the whole sharply defined, and the rich supply of *Alima* larvæ brought home by the Challenger furnishes us with a very complete series of stages in the growth and development of several species of *Alima*, and thus shews that the history of all of them is essentially the same, and that they differ from all the other Stomatopods in the possession of numerous common characteristics which are also points of resemblance to the adult *Squilla*, a conclusion which receives added weight from the fact that Faxon has reared a young *Squilla empusa* from an *Alima* larva.

The complete history of the *Alima* which is furnished by the Challenger material is all the more valuable since Claus, who has given us, in his paper above quoted, a very complete history of the young stages of the *Erichthus* larva in all its more important modifications, had access to much more scanty material for studying the *Alima*. It is true that he gives figures and descriptions of many forms, but they are all well advanced and have the same number of somites and appendages as the adult Stomatopoda, and the fact that the Challenger collection contains consecutive series of several species of *Alima* from a very early stage up to the mature larva, with unmistakable characteristics of the genus *Squilla*, is therefore of great scientific interest.

The fully grown *Alima* is usually much larger than any of the *Erichthi*, and among the largest known pelagic larvæ. It leads an active swimming life, pursuing and capturing with the greatest rapacity the Copepods and other small Crustacea which form the chief part of its food. Its metamorphosis is slow, and the wide distribution of most of the species of *Squilla* is undoubtedly due to the fact that the larva is carried to distant localities by the winds and currents, but notwithstanding the great size, often 2 inches or more, which is attained by the fully-grown larva, the young *Alima*, even of the largest species, is very minute, and it is probable that all *Alimæ* hatch from the egg in the *Alima* form and that the *Erichthoidina* stage has been entirely dropped from their metamorphosis.

[1] Metamorphose der Squilliden, *Abhandl. d. k. Gesellsch. d. Wiss. Göttingen*, Bd. xvi. pp. 111–163, Tafs. i.–viii., 1871.

Although Claus decided that they are young *Lysiosquillæ* they show their relationship to the genus *Squilla* as distinguished from *Lysiosquilla* by the following characteristics, all of which are shared by all fully-grown *Alima* larvæ. The dactylus of the raptorial claw has on its inner edge a small number of marginal spines, usually about five or six; the hind body is wide and flat, and the postero-lateral angles of the abdominal somites end in acute spines. The outer edge of the proximal joint of the uropod is bordered by a small number of spines, usually less than eight, and the inner one of the two spines on the ventral process from the posterior edge of the basal joint of the uropod is longer than the outer, and it has a tooth or lobe on its outer edge; and the telson has six marginal spines with minute secondary spines between the submedians, and four or more larger secondary spines between the submedian and the second or intermediate, and usually a single one internal to the base of the third or lateral marginal spine. While it is true that all of these characteristics are not exhibited by every adult *Squilla*, there are no Stomatopods except those of this genus in which they are all united, and they are all of them present in most *Squillæ* and in all the *Alimæ*.

Joined to the fact that Faxon has reared a *Squilla* from an *Alima*, they indicate very clearly that the *Alimæ* are *Squilla* larvæ, and as we know of no other type of larva which can be referred to this genus, the present state of our knowledge indicates that all *Squillæ* have *Alima* larvæ. As it can be shown very conclusively that the *Alima* is an *Erichthus*, which has become accelerated in development and has dropped its *Erichthoidina* stage, and has become peculiarly adapted for a rapacious pelagic life, it is highly improbable that this change has taken place more than once, and as I shall give reasons for believing that it occurred very soon after the evolution of the genus *Squilla*, and that the larva of the most primitive of the true *Squillæ* is an *Erichthus*-like *Alima*, the conclusion that all the *Alimæ* are *Squilla* larvæ is warranted by the facts. The validity of these general conclusions can be better estimated after reading the descriptions of the larvæ which follow, but these descriptions will be the more intelligible if an outline of the generalizations to be drawn from them be kept in mind.

The *Alima* larva is characterised by the great elongation of the body, the possession of a flattened elongated carapace, with the posterior median dorsal spine absent or rudimentary, the elongated abdomen and usually several of the posterior thoracic somites exposed behind the posterior edge of the carapace, by the very great elongation of the region between the antennæ and the labrum, and by the fact that the eyes and eye stalks are usually exposed on the sides of the long slender rostrum. The carapace is narrow and its width is usually one-third or one-fourth of its length, although its total length makes a much smaller part of the total length of the body than it does in the *Erichthus* larva, as its increased length is more than overbalanced by the great elongation of the hind body. The older specimens of *Alima* are usually much larger than most of the *Erichthus* larvæ, and the inner one of the two spines which project backwards from the

ventral surface of the basal joint of the uropod is usually much longer than the outer, and is usually furnished with a tooth on its outer edge, and in the older specimens there are indications, underneath the cuticle, of spines on the inner edge of the dactylus of the raptorial claw. In his classical paper on the Metamorphosis of the Stomatopoda, Claus pointed out that there are so many features of resemblance between the *Alima* and the various forms of *Erichthus* that the larval nature of *Alima* cannot be doubted. Milne-Edwards and Dana had found it difficult to draw any line between the two genera; the first-named writer placing in the genus all Erichthidæ in which the ocular segment is exposed, while Dana includes in it those forms in which the distance from the anterior edge of the carapace to the mouth is greater than the distance from the mouth to the posterior edge. Claus shows that neither of these features serves to discriminate between *Alima* and *Erichthus* in every case, and he figures and describes a larval type which is intermediate between the two, having the elongated flattened carapace and the exposed eyes, but the mouth well forward, and the thoracic region well covered by the carapace. For this intermediate larval type he proposes the name *Alimerichthus*. Claus was not able to connect any one of his *Alimæ* with a specific adult, but he shows that they resemble the adults of the *Squilla* type very closely, and he correctly decides that they are the larvæ of this type, although he erroneously believes that they belong to the *Lysiosquilla* branch, rather than to the true *Squillæ*.[1] He says there can be no doubt that we must seek their adult representatives in the *Squilla*-group, and that the *Alima* larva, as distinguished from *Erichthus*, belongs exclusively to the genus *Lysiosquilla*, which is characterised, like the *Alima* larva, by the elongation and loose articulation of the abdomen. The lower members of the genus *Squilla* are loosely articulated, like the *Lysiosquillæ*, and the hind body is about as long in the one genus as it is in the other, and there is therefore no reason for believing that any of these larvæ are young *Lysiosquillæ*, although later researches have shown that he is correct in his surmise that they pertain to the *Squilla*-group.

In a paper which was published in 1879[2] I described a series of *Alima* larvæ, which were procured in abundance in the Chesapeake Bay, a locality where *Squilla empusa* is common, while no other Stomatopod is known to occur there, and I therefore advanced the opinion that this larva, a young stage of which is shown in figs. 4 and 5 of Pl. I., is a young *Squilla*. Three years before, Faxon reared from a similar but slightly more advanced larva, a young *Squilla*, which had the characteristics of the adult *Squilla empusa*, and although his results were not published until 1882[3] the proof that *Alima* is a young *Squilla* is due to him. It is of course possible that some species of *Lysiosquilla* may also pass through an *Alima* stage, but I shall show that, among

[1] Metamorphose der Squillideu, p. 154.

[2] On the larval stages of *Squilla empusa*.

[3] Selections from Embryological Monographs compiled by Alexander Agassiz, Walter Faxon, and E. L. Mark, I. Crustacea, Cambridge, 1882, *Bull. Mus. Comp. Zool.*, vol. ix. No. I., pl. viii. figs. 2, 3.

the lower *Lysiosquillæ*, in the subgenus *Coronis*, the larva is not an *Alima* but a *Squillerichthus*, and if it be true that *Squilla* and *Lysiosquilla* represent two divergent stems, and that their lower representatives are most closely related, it is not at all probable that any species of *Lysiosquilla* passes through an *Alima* stage, for if it were the case we should be forced to believe that the higher *Lysiosquillæ* have independently acquired the same secondary larval form as the higher *Squillæ*.

While Claus has given us a very complete history of the *Erichthus* larva his collections did not furnish a connected series of *Alima* larvæ, and although he points out the possibility that the very young larva which had been figured by Fritz Müller,[1] as well as a very similar one from Messina which he himself figures,[2] are young Alimæ, he was unable to obtain any of the intermediate stages, and my paper on the larval stages of *Squilla empusa* is the only one in which a tolerably complete series of *Alima* larvæ are figured. In this paper I showed that the distinctive characteristics of the larva are present at a very early stage of development, and that it is in all essential respects an *Alima* at a time when the last three thoracic somites are not yet marked out, and when there are no appendages between the large raptorial limbs of the second thoracic somite and the first abdominal appendages. I also pointed out the great probability that this larva leaves the egg as an *Alima* rather than as an *Erichthoidina* or an *Erichthus*; a probability which is strengthened by the fact that Fritz Müller has figured an egg containing a larva which is probably in this stage.

Squilla (*Alima*) *gracilis*.—The Challenger collection contains a number of larvæ which were collected in the tow-net at St. Vincent, and from these I have been able to select a series of *Alimæ*, which give a much more complete history of the growth and gradual modification of the larva than that which I obtained in 1879.

This series of larvæ, *Alima gracilis* of Milne-Edwards (*Alima angustata*, Dana) is shown in Pl. IV. figs. 4–6, Pl. V. fig. 3, Pl. VI. figs. 3–5, and Pl. VIII. figs. 4–6.

Its distinctive or specific characteristics are as follows:—The body is narrow and greatly elongated, the exposed hind body making about half the total length as measured from the tip of the long slender rostrum. The raptorial claw of the second thoracic appendage (Pl. VIII. fig. 5) is narrow and greatly elongated, and the dactylus is only about half as long as the second joint.

The telson is remarkably long and narrow, and in the older larvæ its length is three times its width. It has six large marginal spines (Pl. VI. fig. 3 and Pl. VIII. fig. 6) with minute spinules between the submedians, and also between the submedian and the intermediate. The lateral edge of the greatly elongated narrow flat carapace is armed with twelve or thirteen small spines and a larger spine projects from the side of the postero-lateral spine near its base. There is a small median dorsal spine on the posterior edge of the carapace, which exposes the last three thoracic somites, and is narrowed posteriorly

[1] *Archiv f. Naturgesch.*, Jahrg. xxviii. Taf. xiii. fig. 1. [2] Metamorphose der Squilliden, fig. 22*B*.

in the older larvæ. The inner spine of the prolongation from the basal joint of the uropod is much longer than the outer one, and it has a rounded lobe on its outer edge. The exopodite is armed on its outer edge with five or six marginal spines. The eyes are pear-shaped and the stalks very long. The mouth in old larvæ is under the posterior fourth of the carapace; the postero-lateral angles of all the abdominal somites are prolonged into acute spines, and the dactylus of the raptorial claw shows traces of five marginal spines.

Alima gracilis is one of the best known and widely distributed Stomatopod larvæ, and any naturalist who has the good fortune to be becalmed in tropical waters should be able to determine the adult to which it belongs without difficulty, as the older Stomatopod larvæ thrive and moult in small aquaria. The very close resemblance between it and the *Alima* from which Faxon reared a young *Squilla empusa* shows beyond doubt that the adult is one of the highly specialized carinate *Squillæ*, and its wide distribution indicates that the adult also is very widely distributed. The most striking difference between it and other *Alimæ* is the great elongation which takes place in the telson during the latest stages. The late appearance of this character indicates that it is shared by the adult, and as there is no known species with a long narrow telson, and as it is hardly possible that an animal which must be one of the largest and most widely distributed of the Stomatopods, should have escaped discovery if it were littoral in its habits, it is probable that *Alima gracilis* is the larva of an unknown, deep-water *Squilla*, with an elongated telson and a long raptorial claw.

The smallest larva in the series from St. Vincent (No. 1) measures $5\frac{26}{100}$ mm. from the tip of the rostrum to the middle line of the telson; the second (No. 2, Pl. IV. fig. 4) measures $6\frac{81}{100}$ mm., the third (No. 3, Pl. V. fig. 3) $9\frac{18}{100}$ mm., the fourth (No. 4, Pl. IV. fig. 5) $11\frac{54}{100}$ mm., the fifth (No. 5, Pl. IV. fig. 6) $17\frac{38}{100}$ mm., and the sixth (No. 6, Pl. VI. fig. 3) $42\frac{83}{100}$, or a little less than Claus' larva,[1] which is a little less than 52 mm. long. This large larva is well known and widely distributed, and the Challenger collection contains numerous specimens from St. Vincent, the west coast of Africa, the Central Pacific, and the vicinity of Cape York.

The youngest larva (No. 1) of the table was not figured as there is no difference, except in size, between it and No. 2, which is shown in Pl. IV. fig. 4. In this larva all the somites of the hind body, except the fifth and sixth abdominal, are distinct, and the outline of the fifth is indicated. The appendages of the sixth abdominal are entirely absent, those of the fifth are rudimentary bilobed pouches, while the first four are well developed and functional, with a very long basal joint, and an appendix interna on the endopodite.

There are no traces of appendages on the last six thoracic somites, and the third,

[1] Metamorphose der Squillideen, pl. viii. fig. 35.

Alima gracilis. Measurements.	In millimetres.						In thousandths of total length.					
	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.
Measurements along middle line:—												
Total length from tip of rostrum to tip of telson,	5·3	6·9	9·1	11·54	17·37	42·83	...	...	...	...	...	...
Total length of carapace including rostrum,	2·8	3·3	5·04	5·82	8·34	20·17	532	544	541	505	492	484
Total length of rostrum,	·96	1·3	1·6	1·84	1·92	3·32	182	187	174	160	110	80
From tip of rostrum to anterior edge of ocular somite,	·96	1·3	1·6	1·84	1·92	3·32	182	187	174	160	110	80
From anterior edge of ocular somite to line joining bases of antero-lateral spines,	·32	·4	·56	·80	·70	1·66	61	58	61	69	41	40
From line joining bases of antero-lateral spines to tip of labrum,	·48	·7	1·2	1·34	3·68	11·10	91	104	131	117	212	266
From tip of labrum to anterior edge of third thoracic somite,	·64	·8	·9	1·20	1·12	2·07	122	116	96	104	64	50
Third thoracic somite,	·05	·08	·08	·10	·13	·41	9	12	8	8	7	10
Fourth thoracic somite,	·10	·11	·11	·13	·13	1·10	18	16	12	11	7	26
Fifth thoracic somite,	·11	·16	·19	·26	·38	1·41	21	23	21	22	22	34
Sixth thoracic somite,	·14	·19	·22	·37	·54	1·41	27	28	24	32	31	34
Seventh thoracic somite,	·19	·22	·27	·40	·58	1·83	36	32	30	35	33	44
Eighth thoracic somite,	·19	·29	·35	·40	·64	...	36	42	38	35	37	...
From anterior edge of fourth thoracic to anterior edge of first abdominal somite,	·78	1·06	1·23	1·65	2·40	6·16	149	153	134	143	138	148
First abdominal somite,	·29	·35	·51	·64	·90	2·24	55	51	56	55	52	54
Second abdominal somite,	·30	·37	·51	·64	·96	2·24	58	53	56	55	55	54
Third abdominal somite,	·26	·37	·48	·56	·96	2·07	58	53	52	49	55	50
Fourth abdominal somite,	·21	·21	·37	·54	·90	2·16	39–49	30	40	47	52	52
Fifth abdominal somite,	·13	·14	·19	·45	·64	1·90	24	21	21	39	37	46
Sixth abdominal somite,	...	...	...	·22	...	·83	...	...	...	19	...	20
Telson on middle line,	·90	1·20	1·65	1·65	3·20	7·05	170	174	178	143	184	196
Total length of abdomen and telson,	2·08	2·64	3·71	4·70	7·55	18·51	395	382	408	408	435	444
Total length of body on middle line,	5·26	6·91	9·18	11·54	17·38	42·83	1000	1000	1000	1000	1000	1000
Measurements of carapace:—												
Total length on middle line including rostrum,	2·8	3·76	5·04	5·82	8·34	20·17	540	548.	541	505	492	484
Length of rostrum,	·96	1·30	1·6	1·84	1·92	3·32	182	187	174	160	110	80
Length of antero-lateral spines,	·40	·53	·67	·72	·84	1·16	076	76	78	62	48	28
Length of postero-lateral spines,	0·72	·93	1·44	1·84	1·76	2·49	287	134	157	160	101	55
Width at bases of antero-lateral spines,	·96	1·34	1·36	1·33	1·76	3·65	182	194	148	115	101	88
Width at bases of postero-lateral spines,	1·52	2·08	2·88	2·88	3·68	6·64	289	300	314	250	212	158
Width of seventh thoracic somite,	...	·32	·51	·51	·48	1·00	...	46	55	44	28	24
Width of eighth thoracic somite,	·27	·32	·51	·56	·51	1·16	52	46	55	48	29	28
Width of second abdominal somite,	·40	·43	·51	·76	·64	1·66	76	61	56	67	·37	40
Width of fifth abdominal somite,	·32	0·43	·40	·75	·64	1·10	60	61	44	65	37	46
Greatest width of telson,	·80	1·02	1·28	1·60	1·92	3·57	152	148	139	139	110	86
Distance between submedian spines of telson,	·45	·53	·51	·77	·54	1·00	85	76	56	67	31	24
First pleopod, basal portion,	·40	...	·51	·69	·74	1·00	76	...	56	60	43	24
First pleopod, exopodite,	·25	...	·51	·51	·70	1·49	46	...	56	44	40	36
Second maxillipod, basal joint,	·27	·32	·40	·56	·38	1·00	52	46	44	49	22	24
Second maxillipod, second joint,	·67	·83	1·12	1·28	1·92	4·98	128	116	122	111	110	119
Second maxillipod, third joint,	·83	1·09	1·44	1·60	2·08	5·23	158	144	157	139	120	125
Second maxillipod, fourth joint,	·25	·24	·32	·32	·38	·66	46	35	35	28	22	16
Second maxillipod, sixth joint,	1·28	1·52	2·24	2·32	3·20	5·40	243	220	244	201	184	129
Second maxillipod, dactyle,	·83	·93	1·36	1·20	1·92	3·65	158	134	148	104	110	88
First antenna, first joint,	·16	·24	·32	·43	·54	1·41	30	35	35	37	31	34
First antenna, second joint,	·11	·18	·22	·28	·32	·91	21	25	14	25	18	22
First antenna, third joint,	·21	·24	·29	·32	·38	1·00	52	35	31	28	22	24
First antenna, flagellum,	·40	·48	·70	·96	1·12	1·41	76	69	77	83	64	39
Eye stalk,	·32	·56	·64	·72	·96	1·66	61	81	62	62	55	40
Eye,	·48	·72	·67	·96	1·12	1·33	91	104	65	83	64	32

fourth, and fifth are short, and wider than long, while the sixth, seventh, and eighth are elongated, and about as long as they are wide. The second antenna has a two-jointed

shaft, and a broad oval exopodite or scale, but no flagellum, and the three-jointed shaft of the first antenna carries two short unjointed terminal pouches. The eye stalks are very long, slender, and transverse, and the eyes broad at the rounded conical end. The long slender rostrum is about half ($\frac{1}{3}\frac{8}{5}$) as long as the carapace, and the distance from its base to its tip is about equal to the distance from its base to the tip of the labrum. The carapace widens posteriorly, and its width between the bases of the antero-lateral spines is more than half ($\frac{1}{2}\frac{8}{6}$) of its width between the bases of the postero-lateral spines. Its lateral edges are straight, and would if prolonged meet at the tip of the rostrum. The carapace and rostrum make up considerably more than half $\frac{5}{1}\frac{4}{0}\frac{4}{0}$ of the total length, and the posterior edge of the carapace, which is nearly transverse, lies on the posterior edge of the sixth thoracic somite, while the tips of the divergent postero-lateral spines are in the plane of the anterior end of the second abdominal somite. The telson is oval and its length is a little ($\frac{1}{1}\frac{7}{5}$) greater than its width. The lateral marginal spines are about midway between the anterior and posterior ends of the telson; the space between them and the intermediate is a little shorter than the space between the intermediate and the submedian. There are seven small teeth between the intermediate and the submedian, and the distance between the submedians is $\frac{8}{1}\frac{5}{0}\frac{5}{0}$ of the total length. There are only three small spines on the outer edge of the carapace at this stage, and they are all behind the middle.

Larva No. 3, $9\frac{1}{1}\frac{8}{0}\frac{8}{0}$ mm. long, is shown in Pl. V. fig. 3. The fifth abdominal somite is now distinct, but much shorter than those in front of it, and its appendages are perfectly formed but small and without the appendix interna. The thoracic somites and appendages are like those of No. 2. The antennæ are like those of No 2, except that the two flagella of the first antenna are divided each into three joints. The rounded conical end of the eye is broader than in the previous stage, and there have been important changes in the relative length of the carapace and hind body. The rostrum is less than half ($\frac{1}{3}\frac{7}{7}$) as long as the carapace, and the distance from its base to its tip is only $\frac{1}{1}\frac{8}{9}$ of the distance from its base to the tip of the labrum. The carapace still has the same general shape, and its lateral edges are straight, with three spines on the posterior half, but its width between the bases of the postero-lateral spines is relatively less, and the width between the bases of antero-laterals is to that between the postero-laterals as 15 to 31, or about 1 to 2. In most other respects this larva is very similar to No. 2.

Larva No. 4 is shown in Pl. IV. fig. 5. It may possibly belong to a different species, as it has only one spine on the lateral edge of the carapace, but if distinct it must belong to some very closely related species, as there are no essential differences in the measurements. The third, fourth, and fifth thoracic somites are shortened and crowded together, and their appendages have appeared as bud-like outgrowths, while the appendages of the sixth, seventh, and eighth thoracic somites are also represented by similar but much smaller buds. The sixth abdominal somite has not yet been separated

from the telson, although its appendage is represented by a minute bilobed bud. This larva therefore has all the appendages of the adult, either functional or represented by buds, and all the somites of the hind body except the sixth abdominal. The outer ramus of the flagellum of the first antenna is now bilobed, and the flagellum of the second antenna is represented by a bud, and the ocular somite is distinct and movable. The rostrum is a little less than half as long as the carapace, and the labrum is still farther back. The width of the carapace between the bases of the antero-lateral spines is $\frac{1}{2}\frac{1}{5}$ of its width between the bases of the postero-lateral spines, and the carapace with the rostrum makes up almost exactly half of the total length ($\frac{5}{10}\frac{0}{0}\frac{5}{0}$). In other respects this larva closely resembles No. 3.

Larva No. 5, $17\frac{3}{10}\frac{7}{0}$ mm. long, is shown in Pl. IV. fig. 6. The sixth abdominal somite is still absent, and its appendages and those of the three last thoracic somites rudimentary, although those of the third, fourth, and fifth thoracic somites have assumed nearly their final form, and the first antenna has its three-jointed flagella.

Although actually longer than that of No. 4, the rostrum is now relatively much shorter, and only about one-fourth ($\frac{1}{3}\frac{1}{0}$) as long as the carapace, and the distance from its base to its tip is less than one-half ($\frac{1}{2}\frac{7}{5}$) of the distance from its base to the tip of the labrum.

The carapace is still shorter, as compared with the hind body, and with the rostrum, it now makes up less than half ($\frac{4}{10}\frac{9}{0}\frac{2}{0}$) of the total length, although its lateral edges are still straight, and its triangular shape is still retained. The greatest change is in the length of the telson, which is now nearly twice as long as wide.

Larva No. 6, $42\frac{8}{10}$ mm. long, is shown in Pl. VI. fig. 3. It has all the somites and appendages of the adult, although the sixth pair of abdominal appendages are rudimentary. The carapace is still more elongated, and although the rostrum is actually longer than it was in stage 5, it is much shorter both as compared with the total length of the body of which it now makes $\frac{8}{10}\frac{}{0}$, and also as compared with the carapace, which is more than five times ($\frac{4}{8}\frac{0}{0}\frac{4}{}$) as long as the rostrum. One of the most prominent characteristics of the fully grown *Alima gracilis* is the great distance of the mouth from the anterior end of the body, and in larva No. 6 the length of the rostrum is little more than one-fourth ($\frac{8}{3}\frac{}{0}$) the distance from its base to the tip of the labrum. The carapace including the rostrum makes a slightly smaller portion of the total length ($\frac{4}{10}\frac{8}{0}\frac{4}{0}$) than at stage 5, and its lateral edges are no longer straight but are incurved near their posterior ends, so that there is no increase in width in the posterior third of the carapace. In the still older larva figured by Claus, this peculiarity is still more marked, and the broadest part of the carapace is some distance in front of its posterior margin; this is more emarginated in stage 6 than it is in younger larvæ, and it crosses the middle of the sixth thoracic somite. The telson is still more narrow and elongated, and the submedian spines (Pl. VI. fig. 3), which have become more and more closely approxi-

mated to each other at each successive moult, are now separated by a space equal to only $\frac{34}{1000}$ or less than $\frac{1}{4}$ of the total length, while in stage 1 the distance between them is $\frac{85}{1000}$ of the total length. As shown in Pl. VIII. fig. 6, there are fourteen short acute spines between the submedians, with still smaller spines between them, and there are fifteen small acute dentations between each submedian and the intermediate of the same side, which is about equal in length to the submedian.

The uropod of a specimen of the same size, which was captured at the surface by the Challenger expedition, between Api and Cape York, is shown in ventral view in Pl. VIII. fig. 4. The exopodite is now divided into a paddle and a second joint, and the latter has five spines on its outer margin. The ventral prolongation from the basal joint ends in a short outer spine and a much longer inner one, which has a rounded lobe on its outer margin, near the base.

From the table of measurements given above the following measurements may be selected as showing the character of the changes through which the larva passes during its growth. They are all in thousandths of the total length from the tip of the rostrum.

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.
Rostrum,	187	182	174	160	111	80
Carapace, exclusive of rostrum,	357	350	367	345	381	404
Width of carapace between bases of antero-lateral spines,	194	182	148	115	101	88
Width of carapace between bases of postero-lateral spines,	301	289	314	249	212	158
Length of abdomen including telson,	382	395	403	408	435	444
Distance between submedian spines of telson,	76	85	56	67	31	24

While *Alima gracilis* differs from ordinary *Alimæ* in many respects, especially the great elongation of the body, the shortness of the carapace, and the elongation of the telson, Claus has figured a series of *Alimæ* which shows that the shorter and wider species are connected with the elongated ones by so many intermediate forms that there can be no doubt that the adults which they represent are all closely related. The Challenger collection also contains great numbers of these intermediate forms, and I give in Pl. VII. fig. 7 and Pl. VIII. fig. 7 figures of the telson and the raptorial claw of one of them, which resembles *Alima gracilis* in the shape of its carpus, while its telson and the general outline of the body are so much like Faxon's larva as to indicate that it is the young of a species of *Squilla* very closely related to *Squilla nepa*. A number of specimens of this larva were collected by the Challenger on April 13, 1876, near Sierra Leone. The carapace makes about half the total length of the body, and it exposes the posterior end of the sixth thoracic somite, while the tips of its postero-lateral spines, each of which has a small secondary spine about midway between the base and the tip, extend backwards to the plane of the suture between the first and

the second abdominal somites. The lateral edge of the carapace has a few, five or six, marginal spines, and a well marked dorsal spine. The postero-lateral angles of the abdominal somites end in acute spines, and the inner and longer of the two basal spines of the uropod has a rounded lobe on its outer edge close to its base. The carpal joint of the raptorial claw is as much elongated as it is in *Alima gracilis*, although the telson is no longer than its width. As the adult form is certainly a *Squilla*, closely related to *Squilla nepa* and *Squilla mantis*, it does not seem necessary to give the larva a provisional name.

Squilla (*Alima*), *empusa*.—In order to render the series of *Alima* larvæ more complete, I give two figures, a ventral and a side view (Pl. I. figs. 4, 5), of a larva which is smaller and probably one moult younger than any of those in the Challenger collection.

The drawings were made from the living larva, which is probably the larva of *Squilla empusa*, and the same as the one which is shown in Faxon's pl. vi. fig. 17. It is 3·216 mm. long and the last six thoracic somites increase uniformly in length from in front backwards, and have no traces of appendages; the sixth abdominal somite is absent, and the fifth very short and without appendages. The telson is longer than wide, narrowed anteriorly and posteriorly, and the four spines between the submedian and the intermediate are nearly as large as the latter. The rostrum is short, and not quite as long as the slightly divergent postero-lateral spines of the carapace, which is oval in outline and nearly as wide in front as behind. It crosses the posterior end of the seventh thoracic somite in the middle line, and the tips of the postero-lateral spines are about opposite the middle of the third abdominal somite. The tip of the labrum is close to the anterior end of the carapace, and the eye-stalks are short, less than half as long as the eyes.

Alima bidens.—Claus has figured and described,[1] under the provisional name *Alima bidens*, an *Alima* larva which is of especial interest, as many of its organs, especially the gills and the dactyles of the raptorial claws, undergo much more complete development during the larval life than is usually the case, and it therefore presents more data than the ordinary larvæ for establishing an identity with some one of the genera of adult Stomatopods.

Although Claus regarded it as the larva of some species of *Lysiosquilla*, I shall show that *Alima bidens* must be referred to the genus *Squilla*, and there is, so far as I am aware, no other Stomatopod larva which exhibit clearer evidences of relationship to a definite adult genus.

It is of course desirable that some one who has the opportunity should actually rear it, and determine in this way the specific adult of which it is the larva, but in the absence of this decisive proof the evidence that it is a *Squilla* could hardly be stronger than it now is.

Claus obtained only a single larva 26 mm. long from the Indian Ocean, and as this

[1] Metamorphose der Squilliden.

Squilla (Alima), empusa. Measurements.	In inches and decimals.	In thousandths of total length.
Measurements on middle line:—		
Rostrum,	·496	153
From base of rostrum to tip of labrum,	·320	101
From tip of labrum to anterior edge of third thoracic somite,	·512	158
Third thoracic somite,	·064	20
Fourth thoracic somite,	·064	20
Fifth thoracic somite,	·064	20
Sixth thoracic somite,	·080	25
Seventh thoracic somite,	·096	30
Eighth thoracic somite,	·112	35
First abdominal somite,	·160	50
Second abdominal somite,	·160	50
Third abdominal somite,	·160	50
Fourth abdominal somite,	·160	50
Fifth abdominal somite,	·048	15
Telson,	·720	223
Total length on middle line,	3·216	1000
Length of carapace on middle line,	1·648	411
Width of carapace between bases of antero-lateral spines,	·704	218
Width of carapace between bases of postero-lateral spines,	·736	228
Width of telson between submedian spines,	·320	99
Width of telson (greatest),	·448	139
Length of abdomen including telson,	1·408	438

specimen, which is shown in Claus's figure 34, has on the dactylus of the raptorial claw two marginal spines besides the terminal one, he derives the provisional specific name from this characteristic.

The Challenger collections contain two specimens of the same larval type; one from the Cape of Good Hope (Pl. IX. figs. 1 and 2), a little older than Claus's larva, and with three spines on the dactylus besides the terminal one, and 25·39 mm. long; and another from the Gulf of Penas, younger than Claus's larva, with only one spine, and 17·57 mm. long. The two specimens, which undoubtedly belong to a single species, differ very slightly from Claus's larva, which may possibly be the young of a distinct species, although the differences are so very slight that it seems best to retain Claus's specific name *Alima bidens* for them all.

Alima bidens is characterised as follows:—The very short and narrow carapace, which has no median dorsal spine, makes with the dorsal rostrum only $\frac{2}{5}$ of the total length, and its deeply emarginated posterior edge exposes the four posterior thoracic somites. The long tip of the slender rostrum is in front of the end of the shaft of the first antenna, and the length of the rostrum is a little more than half the length of the carapace, measured on the middle line from its base. The antero-lateral spines of the carapace are unusually long and divergent; the tips of the long postero-laterals are opposite

the middle of the first abdominal somite, and they have two or three small secondary spines on their inner edge, while the lateral margin of the carapace, immediately anterior to the base of the postero-lateral spine, has two well-marked lateral spines on each side.

The hind body is greatly elongated, making about $\frac{10}{17}$ or a little less than $\frac{3}{5}$ of the total length from the tip of the rostrum. In older larvæ the abdomen is depressed, and its width is equal to $\frac{1}{5}$ of the total length. The inner spine of the basal prolongation of the uropod is much longer than the outer, and it has a small tooth on its outer margin, about half way between the base and the tip. The telson is slightly elongated, with six marginal spines, and with secondary dentations between the submedians, and also between the submedian and the intermediate. The eye-stalks are nearly as long as the eyes, and the mouth is a little behind the middle point of the carapace, as measured from the tip of the rostrum.

In Claus's larva there are three secondary spines on the inner edge of the postero-lateral spine of the carapace, while there are only two such spines in each of the Challenger specimens.

In the smallest of the Challenger specimens the dactylus of the raptorial claw has a single marginal spine besides the terminal one, the uropods are very small, and the gills are represented by simple pouches on the exopodites of the first five pairs of abdominal appendages. The carapace, with the rostrum, makes $\frac{412}{1000}$, the hind body $\frac{588}{1000}$, and the width of the abdomen $\frac{206}{1000}$ of the total length.

In the older specimen (Pl. IX. fig. 1) the dactylus is armed with three well-developed marginal spines besides the terminal one, the uropods are nearly half as long as the telson, with the exopodite divided into a broad rounded paddle and a second joint which is fringed with six marginal spines, and the prolongation from the posterior edge of the ventral surface of the basal joint is as long as the exopodite, and ends in a short acute curved outer spine and a much longer inner spine, which has a tooth on its outer margin about half way between the base and the tip.

The carapace has a well-marked median carina; the postero-lateral angles of the broad flat abdominal somites all end in acute spines, and there are two submedian carinæ, ending posteriorly in spines, on the dorsal surface of the sixth abdominal. The telson has a median longitudinal carina, and is slightly longer than wide. Its lateral edges, from the anterior edge to the tips of the intermediate marginal spines, are nearly parallel; between the intermediates and the submedians they are inclined inwards and backwards at an angle of 45° with the long axis of the body, while between the submedians they are inclined inwards and forwards. The lateral marginal spine (fig. 2) is nearer to the intermediate than to the anterior edge, and it has a single minute spine internal to its base. The intermediate is longer than the lateral or the submedian, and there are twelve or thirteen small spines between it and the submedian, and there are about twenty very minute spines between the submedian and the middle line.

In this larva, which is 1 inch long, the carapace makes, with the rostrum, $\frac{400}{1000}$, the exposed hind body $\frac{600}{1000}$, and the telson $\frac{200}{1000}$ of the total length.

Even if the close resemblance between this larva and the one from which Faxon reared a young *Squilla empusa* did not indicate that *Alima bidens* is also a *Squilla*, this could be inferred with great certainty from the examination of the larva itself, since it resembles the adults of this genus in the presence and in the small number of spines on the inner edge of the dactylus of the raptorial claw, in the depression and width of the hind body, in the presence of a median-dorsal carina on the carapace and on the telson, in the presence of acute spines on the postero-lateral angles of the abdominal somites, in the presence and in the small number of marginal spines on the outer edge of the proximal joint of the exopodite of the uropod, in the relative length of the two spines of its ventral process, in the presence of a secondary tooth on the outer edge of the inner and longer spine, in the relative positions of the marginal spines of the telson, in the presence of a single minute dentation inside the base of the lateral, and a number of dentations (more than three) between the intermediate and the submedian. While it is true that there are some adult *Squillæ* which do not shew all of these characteristics, and while no one of them is in itself perfectly diagnostic, it is also true that there are no Stomatopods in which they are all united except members of the genus *Squilla*, and we may therefore decide, with all the certainty which is possible in absence of direct proof, that *Alima bidens* is the larva of one or perhaps of two species of the higher carinate *Squillæ*. The presence of three secondary spines on the inner edge of the postero-lateral spine of the carapace of Claus's larva, and of only two in our specimen, possibly corresponds to a specific difference between the adults.

Alima macrophthalma.—The Challenger collection contains a number of specimens of an *Alima* larva of a type which is quite different from that of which *Alima gracilis* is an example, and I have selected from a surface gathering, made near Cape Howe, the series which is shown in Pl. VII. figs. 1–6; Pl. VIII. figs. 1–3.

It is possible that these are not all of one species, but the differences between them are so slight that, if not the same, they must at least belong to adults which are very closely related, and as I am not able to identify the larva with any of the published descriptions, I propose for it the provisional name *Alima macrophthalma*, on account of the great size of the eyes as compared with the very small eye stalks.

The youngest larva which I have found, No. 1, is essentially like No. 2. The telson is shown in Pl. VII. fig. 2; No. 2, which is shown in Pl. VII. fig. 1, is $4\frac{9}{10}$ mm. long; No. 3, shown in fig. 4, is $6\frac{4}{10}$ mm. long; No. 4, shown in fig. 5, is $8\frac{4}{10}$ mm. long; No. 5, shown in Pl. VIII. fig. 1, is $8\frac{75}{100}$ mm. long; No. 6, shown in fig. 2, is $11\frac{11}{100}$ mm. long, and No. 7, shown in Pl. VIII. fig. 3, is 19 mm. long.

The most prominent diagnostic characteristics of *Alima macrophthalma* are as follows. The eye-stalks are very short, and the eyes large with very broad tips; the

labrum is near the middle of the carapace, which is narrow and elongated, exposing the fifth, sixth, seventh and eighth thoracic somites, and very much shorter than the elongated hind body. The carapace has a median dorsal spine, about as long as the antero-lateral spine, on its posterior edge, and there is a single acute straight spine on the lateral margin of the carapace, on each side, immediately anterior to the postero-lateral, the tip of which reaches nearly to the line of the anterior edge of the first abdominal somite.

In the younger larvæ the posterior edge of the carapace is transverse, and the telson is narrowed anteriorly, while in older larvæ the carapace is deeply emarginated, and the lateral edges of the telson nearly parallel. In the oldest larva the inner spine of the uropod is longer than the outer, with a rounded lobe on its outer edge, the abdomen is depressed, about as wide as the carapace between the bases of the antero-lateral spines, and the postero-lateral angles of all the abdominal somites end in acute spines.

This series, together with the *gracilis* series, gives a very complete picture of the changes which the *Alima* larva undergoes during its larval life. In the youngest stage which was observed (Pl. VII. figs. 1 and 2) the shaft of the first antennæ has only two joints, and the appendage ends in only two rami. There is no flagellum on the second antenna, and no appendages between the raptorial second thoracic limbs and the first pair of abdominal appendages. All the four thoracic somites are wider than long, and the third, fourth, and fifth are equal in length, and more than half as wide as those which follow. The abdomen is narrow, very slightly wider than the thorax, with five distinct somites, the last of which is short without appendages, while the appendages of the fourth are rudimentary. Those of the third, second, and first are functional, long and slender, with a long appendix interna. The tip of the labrum, which has no spine, is slightly anterior to the middle line, and the greatest width of the carapace is slightly less than its length. It narrows a little posteriorly, and its width between the bases of the postero-lateral spines is very slightly greater than its width between the bases of the antero-laterals.

The width of the telson at its anterior end is about half the greatest width (see figs. 1 and 2) and it is also slightly narrowed posteriorly. The posterior border, between the submedian spines (fig. 2) is straight and transverse, with about eighteen small spines.

The intermediate spines are near the middle of the telson, separated by a slight interval from the laterals, and by a much longer interval from the postero-median, with some intervening dentations which are about as large as the primary spines.

At the next stage (No. 3, fig. 4) the appendages are as before, except that the fourth abdominal appendages are larger, and the fifth pair are now present as rudiments. The position of the labrum and the shape of the carapace is essentially as in stage 2, and the telson is also nearly the same except that its posterior border is slightly emarginated. At the next stage (No. 4, fig. 5) the flagellum of the second antenna, the appendages of the third thoracic somite, and those of the sixth abdominal somite, are all represented by minute buds, and the third thoracic somite has become shorter than

the fourth and fifth. The outline of the carapace is about as before, except that it is now deeply emarginated on the middle line. The posterior border of the telson is slightly emarginated; the submedian spines have approached each other, and the intermediates, which are now much larger than the seven secondary dentations, have moved backwards, as have also the laterals.

In the next stage (No. 5, Pl. VIII. fig. 1) more important changes have taken place. The third, fourth, and fifth thoracic appendages are represented by buds, and their somites have become reduced in length, so that the sixth is as long as all three of them. The abdomen is now much wider than the thorax, and its somites all end posteriorly in acute spines. The labrum is a little further back, and the anterior end of the carapace narrower than at stage 4, but the telson is essentially like that of stage 4, although it is a little more emarginated in the middle line. In stage 6 (fig. 2) the labrum is still further back, the flagellum of the second antenna and the appendages of the third, fourth, and fifth thoracic somites are elongated, and the latter are obscurely divided into joints; the appendages of the sixth, seventh, and eighth thoracic somites are represented by buds, the abdomen is wider and more depressed, and the appendages of the sixth somite are parallel but well developed. The space between the lateral and the intermediate spines of the telson is now equal to the space between the intermediate and the submedian, and the posterior border is deeply notched on the middle line. In the oldest larva in this series (No. 7, fig. 3) the appendages all have essentially their adult forms, and the more important changes are the lengthening of the hind body, the flattening and widening of the abdomen, and especially the widening of the sixth abdominal somite and the anterior end of the telson. This is now nearly rectangular, and deeply notched on the middle line; the submedian spines are more approximated, and the intermediates further back.

Although the collection contains no specimens which serve to connect this larva with a specific adult, its close resemblance to the more typical *Alimæ*, especially *Alima bidens*, gives every reason for believing that it is the young of one of the higher multicarinate species of the genus *Squilla*.

The specimens are all from the coast of Australia, and all these which were drawn were from Cape Howe and its vicinity.

Alimerichthus.—Inasmuch as the *Erichthus* type of Stomatopod larvæ presents a very much greater diversity of forms than the *Alima* type, and as it is preceded by a *Erichthoidina* stage which is absent in the *Alima* larvæ, there can be no doubt that the latter type is a secondary modification of the *Erichthus* type, and that the greatly elongated *Alimæ* like *Alima gracilis* (Pl. VI. fig. 3) are more divergent from the primitive larva than the shorter and broader forms like *Alima macrophthalma* (Pl. VIII. fig. 3). Although Milne-Edwards and Dana have attempted to show that the two types are sharply separated, Claus has pointed out that among the *Alimæ* themselves there is a series of larvæ,

which, starting with *Alima gracilis*, with its short carapace and elongated hind body, leads, through many intermediate types, to a larva which is short and wide, and almost completely covered by the elongated carapace, like an *Erichthus*, although its general structure is *Alima*-like. For this larva, which he justly regards as the ancestral form from which the *Alima* larvæ have been produced, Claus proposes the provisional generic name *Alimerichthus*, as expressing its double relationship, to *Alima* on the one hand, and *Erichthus* on the other.

He figures[1] a single advanced larva of this type 18 mm. long from the Indian Ocean, but as he gives no account of its early stages, the occurrence in the Challenger collection of younger specimens of this type is a matter of great interest, as these younger larvæ show that the young *Alimerichthus*, like the young *Alima*, passes through a stage in which the last six thoracic somites have no appendages, while the raptorial limbs of the second thoracic somite and the first pairs of abdominal appendages are well developed and essentially like those of the adult.

I have selected from a collection made, February 29, 1886, in the South Atlantic, off the coast of South America, in lat. 36° 9′ 8″ S., long. 48° 22′ W., the two specimens which are shown in Pl. VIII. fig. 8, and Pl. IX. fig. 3, and which represent a form which is very closely related to, but probably not identical with the one figured by Claus. The youngest, shown in Pl. VIII. fig. 8, is 8·715 mm. long, and the next stage, shown in Pl. IX. fig. 3, is 15·52 mm. long, while Claus's *Alimerichthus* is 18 mm. long, so that we probably have, in this series, three successive moults in the history of the larva for which Claus's generic name may be retained without a specific name. *Alimerichthus* is characterised as follows—A short wide *Alima* with a short hind body which is wide and flat in the older larvæ. The mouth is near the middle of the carapace, and the rostrum is less than half as long as the carapace, which has a median dorsal spine, and moderately long antero- and postero-laterals. There is a secondary spine on the inner edge of the postero-lateral close to its base, and a very prominent acute spine projecting outwards from the lateral edge of the carapace, about midway between the bases of the antero- and postero-lateral spines, and two or three smaller ones projecting inwards between this and the one at the base of the postero-lateral. The length of the carapace, measured on the middle line, from the tip of the rostrum, makes much more than half the total length, and it covers all of the thorax except the tip of the eighth somite, while the tips of the postero-lateral spines are in the line of the anterior edge of the telson. The eye stalks are about as long as the eyes, which have swollen globular tips, the width of the carapace equals about one-third the total length, the telson is wider than long, with six marginal spines, and numerous secondary spines between the submedians and also between each submedian and the adjacent intermediate. The inner spine of the basal prolongation of the uropod is slightly longer than the outer,

[1] Metamorphose der Squilliden, p. 147, Taf. viii. fig. 30.

and there are few (five or six) marginal spines on the outer edge of its exopodite. In the older larvæ the dactylus of the raptorial limb shows traces of six spines besides the marginal one.

In the youngest *Alimerichthus* which has been observed (Pl. VIII. fig. 8) the flagellum of the second antenna is represented by a bud, as are also the appendages of the third thoracic somite, and the third, fourth, and fifth thoracic somites are crowded together so that the sum of their lengths is about equal to the length of each one of the three last thoracic somites, upon which there are no traces of appendages. There are five pairs of fully developed and functional abdominal appendages, and five distinct abdominal somites, the first four wider than the thorax, but the fifth very narrow and deeply constricted off from the telson, upon the anterior edge of which the sixth pair of abdominal appendages are represented by buds. The telson is wider than long, and nearly four times as wide as the abdomen. It has six pairs of marginal spines with numerous minute secondary spines between the submedians, ten or eleven on each side between the submedian and adjacent intermediate, and a single one internal to the base of the lateral. The margin of the telson, between the submedian and the intermediate, makes an angle of about 45° with the principal axis of the body. A comparison of this larva with the corresponding stage of *Alima gracilis* (Pl. IV. fig. 5), or of *Alima macrophthalma* (Pl. VIII. fig. 1), shows that there is every reason for believing that it is preceded by an earlier stage like the youngest observed stage of *Alima gracilis* (Pl. IV. fig. 4), of *Alima macrophthalma* (Pl. VII. fig. 2), or *Alima (Squilla) empusa* (Pl. I. fig. 4), and that at this time the third, fourth, and fifth thoracic somites are long and without appendages like the sixth, seventh, and eighth; the fifth abdominal somite and its appendages absent or rudimentary, the sixth absent, and the telson spatulate, with the submedians wide apart, and the secondary dentations between the submedians and intermediates about as large as the primary spines. As we know that some, and probably all, of the *Alima* larvæ hatch from the egg in this condition, and do not pass through a free *Erichthoidina* stage, this is undoubtedly true of the *Alimerichthus* also.

In the next stage which has been observed (Pl. IX. fig. 3) the appendages and somites are all present, the exopodites of the first five abdominal appendages carry at their bases the rudimentary buds which are to become the gills, the telson is shorter and wider than before, and the intermediate marginal spines have travelled backwards until the posterior margin of the telson is nearly transverse between them. The sixth abdominal appendages are still small, but in the next stage, the one shown in Claus's fig. 30, they are nearly as long as the telson, with six or seven marginal spines on the outer edge of the exopodite and with the inner spine longer than the outer, with an obscure lobe on its outer margin near the base. The whole hind body is now wide and flat, and there are indications of five or six marginal spines on the inner edge of the dactylus of the raptorial claw.

I have shown that the *Alima* larva resembles the adults of the genus *Squilla* in the depression of the hind body, the presence of marginal spines on the dactylus of the raptorial claw, in the small number of marginal spines on the outer edge of the exopodite of the uropod, in having its inner spine longer than the outer, with a lobe or dentation on its outer edge, and in the presence of numerous secondary spines between the submedian spine and the intermediate marginal spine of the telson.

In all of these respects *Alimerichthus* resembles *Alima*, and it is, therefore, beyond question, a *Squilla* larva, but it differs from *Alima* in the great width of its telson and the absence of spines on its abdominal somites, as well as in its resemblance to the more primitive *Erichthus* larva.

The comparative study of the adult Stomatopoda teaches that the genera *Lysiosquilla* and *Squilla* are two divergent branches from a common stem, and that the primitive *Squillæ* were more like this stem-form, and therefore more like *Lysiosquilla* than the more specialized species. In the genus *Squilla*, *Squilla* (*Chlorida*) *microphthalma* and its allies are the closest living representatives of the stem-form, and they resemble the lowest species of the genus *Lysiosquilla* in the small size and the approximation of the eyes, the small size of the antennæ and uropods, the loose articulation of the hind body, and the width of the telson. I shall show further on that the larva of *Lysiosquilla*, as well as of the more primitive genera of Stomatopoda, is an *Erichthus*, and that all the true *Alimæ* are *Squilla* larvæ. The common ancestor of *Lysiosquilla* and *Squilla* must therefore have passed through an *Erichthus* stage. If it be true that the characteristics of the *Alima* larva are the result of secondary modification, it is of course quite possible that the most modified adult *Squillæ* might have their larvæ the least modified, but in the absence of any proof that this is the case, it is more natural to believe that the most typical *Alimæ* are the young of the most typical *Squillæ*, and that *Alimerichthus*, the most primitive and *Erichthus*-like of the *Alimæ*, is the young of a smooth loosely articulated and primitive *Squilla*, like *Squilla* (*Chlorida*) *microphthalma*. While this conclusion cannot be accepted without question, in the absence of direct proof, there is much reason for believing that *Alimerichthus* is the larva of a *Squilla* closely related to *Squilla microphthalma*, and this decision receives added force from the fact that several of the most conspicuous peculiarities of *Alimerichthus* as distinguished from *Alima*, such as the width and shortness of the telson, and the loose articulation of the hind body, are points of resemblance to *Squilla microphthalma*. In the true *Alimæ* the postero-lateral angles of the abdominal somites end in acute spines, which are not developed in *Alimerichthus*, and, as *Squilla microphthalma* is the least costate of the true *Squillæ*, this is another point of resemblance. It is not probable, however, that *Alimerichthus* is specifically identical with *Squilla microphthalma*, and future research may prove that its adult form is an unknown and still more primitive *Squilla*.

The Lysiosquilla larvæ, and the Metamorphosis of Lysiosquilla.

If my decision that all the *Alima* larvæ are young *Squillæ* be correct, we must look for the larvæ of all the other genera of Stomatopoda among the *Erichthi* and *Squillerichthi;* or, as *Squillerichthus* is simply an advanced *Erichthus*, among the *Erichthi.*

The series of *Erichthus* larvæ is so complete, and transitional forms are so numerous, that it is very difficult to divide the group into minor groups; and while it is obvious that there are several distinct larval types, they are so intimately united by intermediate forms that the attempt to study them is very puzzling. The genera merge into each other in such a way that it is difficult to find any strictly diagnostic characteristics, but this is no more than we should expect from the absence of sharply limited genera among the adult Stomatopoda.

I have shown that the species of *Lysiosquilla*, in which genus I include *Coronis*, and the species of *Squilla* including *Chloridella*, exhibit proofs of divergent descent from a common stem form, which was more like *Coronis* and *Chloridella* than it was like the more divergent *Lysiosquillæ* and *Squillæ;* and as I have also shown that the larvæ of all the species in the *Squilla*-branch from this common stem are *Alimæ*, we naturally turn to the *Alima*-like *Erichthi* in our search for the larval type of the second or *Lysiosquilla*-branch.

In addition to their features of relationship to the adult genus *Squilla*, the *Alima* larvæ agree with each other in the general occurrence of marginal spines on the lateral edges of the carapace, the length of the telson, which is almost always greater than its breadth, the flatness of the hind body and the presence of marginal spines on the inner edge of the dactylus of the raptorial claw. *Squilla* and *Lysiosquilla* agree with each other in the flatness of the hind body, and in the presence of spines on the dactylus, but the *Alima* larva shows its relationship to *Squilla* by the presence of numerous secondary spines between the submedian and intermediate marginal spines of the telson, by the small number of spines on its dactylus, and by the fact that the inner spine of the uropod is always longer than the outer.

Now there is a group of *Erichthus* larvæ, of which *Erichthus duvaucellei* (*Lysiosquilla maculata ?*) (Pl. X. fig. 7), and *Erichthus multispinosus* (*Lysiosquilla excavatrix*) (Pl. XI. figs. 1, 2 and 3) are examples, which show by the flatness of the hind body, and by the presence under the cuticle of the dactylus, in the older larvæ, of traces of marginal spines, that they are either *Squilla* or *Lysiosquilla* larvæ. Claus refers them to the genus *Squilla*, but as the marginal spines are usually more numerous than they are in any known *Squilla* or in the *Alima* larva, we must exclude the genus *Squilla* in our attempt to trace them to their adult form. In some of these larvæ there are as many as seventeen of these rudimentary spines on the dactylus, and they are seldom less than six, and there

is ample internal evidence, drawn from other structural features, to show that they are *Lysiosquilla* larvæ; and in addition to this indirect but satisfactory evidence, I am now able to furnish more direct proof, as I have reared a *Lysiosquilla*, *Lysiosquilla excavatrix*, from one of those larvæ (Pl. X. figs. 14, 15), and one of the Challenger specimens (Pl. X. fig. 7) exhibits the characteristic transverse pigment stripes and other specific characteristics of *Lysiosquilla maculata*, while another advanced larva of this type (Pl. XI. figs. 6, 8, 9) exhibits the flattened oval thin membraneous appendages to the exposed thoracic limbs which is characteristic of the lower *Lysiosquillæ*.

This larval type, for which I propose the provisional generic name *Lysioerichthus*, merges into the *Erichthus* of *Gonodactylus* and that of *Pseudosquilla* in such a way that it is often difficult to decide whether a certain larva is to be referred to the one or the other of these groups, but the *Lysioerichthus* may usually be distinguished from the other *Erichthi*, by the position of the postero-lateral spines of the carapace, which, when seen in profile (Pl. X. figs. 7, 14; Pl. XI. figs. 2, 3) are separated by a wide interval from the dorsal middle line; they are either on the ventral edge of the carapace or else they are much nearer to it than to the dorsal middle line, while the reverse is the case in the *Erichthus* of *Pseudosquilla* (Pl. XII. fig. 6) and that of *Gonodactylus* (Pl. XV. figs. 11, 12). In addition to this feature, which is, I believe, strictly diagnostic, they are also characterised among the *Erichthi* by the width and flatness of the hind body, and by the great depth of the carapace, the lateral edges of which are ventrally infolded, as shown in the figures.

During their younger stages they exhibit a most striking resemblance to the *Alima* larva (Pl. XI. fig. 1; Pl. XII. fig. 4), although this resemblance is entirely lost by the older larvæ.

In addition to the greater number of spines on the dactylus of the raptorial claw they are also distinguished by other features, all of which indicate their identity with *Lysiosquilla*. The telson is wider than long, like that of *Lysiosquilla*, and unlike that of *Alima* and *Squilla*, where it is, almost without exception, longer than wide; and between its intermediate and submedian marginal spines there is usually only one secondary spine, and never more than four. This is true of the adult *Lysiosquilla* also, while in all the adult *Squillæ* and all the *Alimæ* the secondary spines are more numerous.

The outer one of the two spines at the end of the ventral prolongation from the base of the uropod is, with rare exceptions, longer than the inner, as is the case, also with rare exceptions, in *Lysiosquilla*, while the reverse is true without any exception in *Alima* and in *Squilla*.

The *Lysioerichthus* is a true *Erichthus*, although it is the most *Alima*-like of the *Erichthi*. Like the *Alima* the young *Lysioerichthus* has numerous marginal spines on the lateral edges of the carapace, although this characteristic disappears as the larva grows older, while it is retained by the fully grown *Alima* larva. In the very young

stages of both types the thoracic region is elongated; there are no traces of appendages on the last six thoracic somites; the hind body is elongated and narrow, and the carapace shallow and flat. This general resemblance to an *Alima* disappears with the growth of the larva, and the fully grown *Lysioerichthus* is not at all *Alima*-like, as its body is short and wide, and the carapace so deep that it covers the sides and part of the ventral surface of the free body, while the hind body also may be bent forwards and entirely covered by the carapace.

These *Erichthi* with a deep carapace and a wide flat hind body are very numerous and widely distributed, and as they are also among the largest of the Stomatopod larvæ we may be confident that they pertain to adults which belong to a widely distributed genus, including many species, some of which are among the largest Stomatopods.

While we cannot feel at all confident that all the genera of adult Stomatopoda are known, it is highly improbable that these larvæ belong to an unknown genus, and we may safely refer them to one of the well known genera. Their large size and the presence of marginal spines on the dactyle exclude *Protosquilla* and *Gonodactylus*, and the depression of the hind body excludes *Pseudosquilla*, and we must therefore refer these larvæ to either *Squilla* or *Lysiosquilla*.

Claus, as I have pointed out, advocates the first view, but the description which follows will show that there is ample internal evidence that they are all *Lysiosquilla* larvæ, and this indirect evidence is rendered all the more conclusive by the fact that I have reared *Lysiosquilla excavatrix* from one of them, while the Challenger collections enable me to trace another to *Lysiosquilla maculata* with nearly equal certainty.

I therefore feel sure that the examination of the descriptions which follow will furnish convincing proof that all these *Erichthi* are young *Lysiosquillæ*, and that all the *Lysiosquillæ* pass through the *Lysioerichthus* stage.

The *Erichthus* larva shown in Claus's figure 14 is very similar to *Lysioerichthus*, but it differs from them all in features in which they all agree with each other, and I shall give farther on my reasons for believing that it is a *Coronida* larva, and therefore equally related to both *Alima* and *Lysioerichthus*.

As I shall soon show, there is reason for distrusting the accuracy of his drawing of the telson of his *Erichthus multispinosus*, which is also exceptional.

Lysiosquilla (*Erichthus*) *excavatrix*.—At Beaufort, N.C., U.S.A., where only two species of Stomatopoda, *Squilla empusa* and *Lysiosquilla* (*Coronis*) *excavatrix*, are known to occur, and where both species are abundant, two types of Stomatopod larvæ are also abundant, and as there is ample evidence to show that one of these, shown in Pl. I. fig. 4, is the young of *Squilla empusa*, it is natural to infer that the other (Pl. XI. figs. 1, 2, 3) is the larva of the Beaufort *Coronis*, *Lysiosquilla excavatrix*, of which Pl. X. fig. 8 represents the adult male. Nearly all the larvæ which I found were in the stage shown in Pl. XI. fig. 1, and all my attempts to rear them in captivity failed, as

they all died in moulting. The newly hatched young are swept out to sea by the tide, and are widely distributed, and the older larvæ are seldom found at Beaufort, but I have procured a few specimens which serve to connect the youngest stage with a larva nearly an inch long, which changed in the house into a young *Lysiosquilla excavatrix*, so that there is little doubt that all the larvæ of this type found there belong to this species.

The youngest larva which is figured is very similar to Claus's *Erichthus multispinosus* from the Indian Ocean, although it is much younger, nor do they belong to the same species, for Claus's specimen has eight or nine, and ours only three, secondary spines between the intermediate and the submedian marginal spines of the telson, although in other particulars there is the closest resemblance between the two.

It has four distinct well-developed abdominal somites with appendages, while the short fifth abdominal somite is not yet separated from the telson. The flagellum of the second antenna and the appendages of the last six thoracic somites are absent, although the somites are present and equal in length, with the exception of the eighth, which is longer than the others. The rostrum is about as long as the carapace, and it has two or three small spines on its lower surface. The carapace covers all the thoracic, but not the abdominal somites, and its general outline, in dorsal or ventral view, is nearly square, but its length slightly exceeds its greatest width, and its width between the bases of the antero-lateral spines is less than between the bases of the postero-laterals. In profile view (fig. 2) the lateral edges are bent downwards below the level of the ventral surface of the thorax, and the chamber which is thus formed is deepest at its posterior edge, so that the mid-dorsal outline and the lateral edge are wide apart posteriorly, and approach each other in an acute angle at the base of the rostrum. On the middle line of the posterior edge there is a slender spine a little shorter than the rostrum, and about equal in length to the curved, divergent postero-laterals, each of which carries a secondary ventral spine near its base, dorsal to which, on the posterior edge of the carapace, there is a small secondary spine on each side, as well as one on the lateral edge posterior to the base of each of the long, divergent and widely separated antero-laterals, and on the lateral edge about halfway between the antero- and postero-laterals there are two secondary spines. The telson is considerably longer than wide, with its posterior edge nearly transverse, its anterior edge narrow, and with six marginal spines on each side, the first, which is longer than the next five, becoming the lateral marginal spine of the adult, is separated from the second or intermediate by a wider space than those between the others. The eye-stalks are about as long as the eyes, which are narrow with globular tips. The raptorial claw is flat and oval, and there is a large prominent spine close to the proximal end of the carpus.

The next larva which is shown as seen from the left and below (fig. 3) is considerably older and larger, and the marginal spines of the rostrum and carapace have

increased in size and in numbers. The sides of the carapace are folded down over the body more than they are in the younger larvæ, and the median dorsal spine is relatively shorter. The appendages of the third, fourth, and fifth thoracic somites are represented by buds, as well as the fifth abdominal appendages, and the three last thoracic somites are now longer than those in front. While I obtained a number of specimens of this stage I found only one older one, which moulted, before I had an opportunity to draw it, into the young *Lysiosquilla excavatrix*, shown in Pl. X. fig. 13, although I was able to make from the moulted skin the drawings of the carapace and telson which are given in figs. 14, 15, and 16, of Pl. X.

Although this larva, the carapace of which was $\frac{12}{20}$ inch long on the middle line, including the rostrum, and $\frac{6}{20}$ inch wide between the bases of the postero-lateral spines, is many stages older than the one last described, the differences are so very great that I at first doubted whether they could belong to the same series, but the consecutive series of stages in the growth of the closely related larva which is described in the next section furnishes satisfactory proof that this is the case. The antero-lateral and dorsal spines are now very short, although the rostrum and postero-laterals are of about the same relative length as before, and none of the marginal spines were visible with the hand-lens under which the drawings were made, except one in front of the base of each postero-lateral and one in front of this by one-third of the distance to the small antero-lateral. The telson (fig. 16) is now nearly rectangular, a little ($\frac{7}{6}$) wider than long, with very long submedian spine, and a nearly transverse but notched posterior border carrying thirty-six small secondary spines with very minute spinules between them. As compared with the submedians the other marginal spines are very small; the laterals are posterior to the middle line and have each a small spinule internal to the base, and one of the three secondary spines which were present in the younger larva has disappeared, while the second is very small, and the third much smaller than the intermediate. The change which takes place between this stage and the next, in the shape of the telson, is fully as great as the difference between the telson at this stage and that of the very young larva, as immediately after the moult the young *Lysiosquilla* has a telson essentially like that of the adult shown in Pl. X. fig. 8, transverse, and about twice as wide as long, with no secondary spines, and with all six marginal spines on the transverse posterior border, and the submedians united in a single median process, as shown in fig. 13.

I am inclined to believe that a small *Erichthoidina* larva, which is occasionally, although very rarely, found on the eastern coast of the United States, is the larva of this species. Faxon has found one of these larvæ at Newport, R.I., and he has figured it in pl. viii. figs. 11 and 12 of his selection from Embryological Monographs.[1] Through the courtesy of Professor Baird I have also had an opportunity to examine a sketch of another specimen which Professor S. J. Smith obtained at the United States Fish Commission

[1] *Bull. Mus. Comp. Zool.*, vol. ix. 1, 1882.

laboratory at Wood's Holl, and I have found one specimen at Beaufort, although sickness in my family prevented me from studying, and my hope of rearing it from preserving it. It died, however, without moulting, like all the young Stomatopod larvæ which I have tried to rear in captivity. It is essentially like the *Erichthoidina*, from Honolulu, shown in Pl. XII. figs. 1, 2, and very similar to Claus's *Erichthoidina gracilis*[1] and *Erichthoidina armata* (fig. 3), and it differs from the *Erichthoidina*, shown in Pl. XII. fig. 3, and from Claus's *Erichthoidina brevispinosa*, which I hold to be young *Gonodactyli*, in the absence of a spine below the base of the postero-lateral, and in the greater relative distance between this spine and the dorsal spine.

I shall give reasons for believing that these differences are characteristic of the *Lysiosquilla Erichthus* as distinguished from the *Erichthus* of *Gonodactylus*, and as we find two corresponding types of *Erichthoidina* it is natural to believe that one becomes converted at last into a *Lysiosquilla*, and the other into a *Gonodactylus*.

I therefore regard Claus's *Erichthoidina gracilis* and *Erichthoidina armata*, the Challenger *Erichthoidina* from Honolulu (Pl. XII. figs. 1, 2), Faxon's larva and Smith's larva as very young *Lysiosquillæ*, and Claus's *Erichthoidina brevispinosa* and the Challenger *Erichthoidina*, from St. Vincent (Pl. XII. fig. 3), as young *Gonodactyli*, for reasons which will be more fully developed in the sequel. If this is true we have a most striking corroboration of the correctness of the opinion so ably and ingeniously advocated by Claus (Crustaceen System) that the Stomatopod larva without appendages upon the last six thoracic somites, in which condition the *Alima* larva leaves the egg, is the phylogenetic descendant of a larva with biramous feet on all these somites, for this change must actually occur during the ontogenetic development of *Lysiosquilla excavatrix*, since Faxon's and Smith's larvæ have biramous appendages on the third, fourth, and fifth of these somites, like those on the first and second, although the youngest *Lysiocrichthus*, shown in our figure has no traces of them on these somites, or upon the sixth, seventh, and eighth.

The great rarity of *Erichthoidina* larvæ may possibly be due to the fact that during this early period of its larval life, the young Stomatopod remains within the burrow of its parent, or it may be that the larva does not usually escape from the egg until this stage is passed, and that the few specimens which are met with at rare intervals are those which have been prematurely hatched.

The analogy of other Crustacea, the various species of *Alpheus*, for example, shows that two closely related species may hatch in different stages, and it is therefore possible that one *Erichthus* may hatch as an *Erichthoidina*, while another hatches in the *Erichthus* stage. It is not impossible that some *Alimæ* may hatch as *Erichthoidinæ*, although there is no evidence that this is the case.

Before I enter upon the general discussion of the *Lysioerichthus* I will describe

[1] Metamorphose der Squilliden, Taf. i. figs. 1, 2.

a few larval formss elected from the numerous Challenger specimens which I refer to this genus, or to the subgenus *Coronis*.

Coronis (*Erichthus*) *minutus*.—From a collection of larvæ taken in the tow-net at St. Vincent I have selected the series which is shown in Pl. XII. fig. 4; Pl. XIII. figs. 1–8, and 11, all of which undoubtedly belong to a single species. This is shown by their general resemblance and also by the accompanying table of measurements. The length of the four specimens, measured from the tip of the rostrum to the tip of the telson, are as follows :—

	No. 1. 4·16 mm.	No. 2. 5·29 mm.	No. 3. 6·49 mm.	...	No. 4. 10·21 mm.
If the length of No. 1, which is 4·16 mm. be successively multiplied by $\frac{5}{4}$, we shall have the following series of numbers, .	4·16	5·20	6·50	8·13	10·16

and the close agreement between the measured and the computed length shows that Nos. 1, 2, and 3, are successive stages, and that there is a stage which is not represented in the collection between Nos. 3 and 4, and that the length of the larva increases uniformly at each moult by one-fourth of its length before the moult. It is hardly conceivable that an accidental collection of unrelated specimens should show such close conformity to a numerical law, and we may safely decide that the larva shown in Pl. XII. fig. 4 becomes transformed, through the stages described, into the one shown in Pl. XIII. fig. 7. This latter larva is so similar to the larva of *Lysiosquilla* (*Coronis*) *excavatrix* that the series from St. Vincent may also be safely referred to an adult of the subgenus *Coronis* of the genus *Lysiosquilla*. It does not seem to have been described, and on account of its small size, I propose for it the provisional name *Erichthus* (*Coronis*) *minutus*.

The diagnostic characteristics of this species are as follows:—A small *Erichthus* with a broad flat hind body, a rostrum less than half as long as the carapace, and with the postero-lateral spines of the carapace ventral, and without a tooth ventral to their base; the raptorial claw (Pl. XIII. fig. 11) is flat and oval, and there is one large spine on the anterior edge of the carpus close to its proximal end. The telson has six primary marginal spines, the intermediates larger than the laterals and having a minute secondary spinule internal to their bases, and one small secondary spine between the intermediate and the submedian. The outer margin of the exopodite of the uropod has few spines, and the basal prolongation ends in a long slender acute outer spine with a broad base, and a very small inner spine. The carapace with the rostrum makes a little more than half the total length, and its posterior edge, which has a small

median dorsal spine, crosses the middle line above the posterior edge of the first abdominal somite. The eyes are nearly cylindrical, with very short stalks, and the hind body is flat and wide.

The youngest larva (No. 1, shown in Pl. XII. fig. 4) is so similar to the one represented in Claus's figure 22 B, that we must believe that they are closely related. The Challenger larva from St. Vincent is 4·16 mm. long, and our measurements indicate that, if there be a younger stage, its length should be 3·33 mm., while Claus's larva, from Messina, is about 3 mm. long, and it is highly probable that it belongs to this species, and is therefore a *Coronis*, although this author held that it is either a *Pseudosquilla* or an *Alima*.[1] The spines of the carapace are longer, and the eyes longer and narrower in our species than in Claus's figure, but these are the greatest differences.

In our larva No. 1 (Pl. XII. fig. 4) the first antennæ have only two branches, the second antennæ have no flagellum, and the third, fourth, fifth, sixth, seventh, and eighth thoracic somites have no traces of appendages, and they are equal in length, although the eighth is wider than the others. The thoracic ganglia are marked off by fissures but they are in contact with each other.

There are five distinct abdominal somites with separate ganglia and functional appendages, each with an appendix interna or retinaculum on the thoracic edge of its endopodite (Pl. XII. fig. 4).

The sixth abdominal somite is obscurely indicated, and its appendage is represented by a bud (Pl. XIII. fig. 1). The carapace has a small dorsal median spine on its posterior edge, the rostrum is about half as long as the carapace, with three small spines on its ventral surface, and about as long as the divergent postero-lateral spines. The lateral edges of the oval carapace are fringed with numerous minute serrations, but there is no large tooth on the ventral side of the base of the postero-lateral spine. The raptorial claws, even at this early stage, are flat and wide, and the carpus has a single prominent tooth close to its base, on its anterior edge.

A profile view of the next stage (No. 2) is given in fig. 11 of Pl. XIII. A small bud now represents the flagellum of the second antenna (Pl. XIII. fig. 4), and the appendages of the third, fourth, and fifth thoracic somites are also represented by buds (Pl. XIII. fig. 5), and the ganglia of the sixth, seventh, and eighth thoracic somites have separated from each other. The sixth abdominal ganglion and somite are now distinct, and the rudimentary appendage (Pl. XIII. fig. 3) consists of a long acute simple spine and two rounded lobes. The posterior edge of the telson, which was transverse in stage 1 is now angulated on the middle line. The next stage is shown from below in Pl. XIII. fig. 6. All the appendages and somites are now represented, the lateral

[1] Metamorphose der Squilliden, p. 144.

edges of the carapace are folded inwards, and the minute inner spine has appeared upon the ventral process of the uropod. The abdomen is now flat and wide and the lateral edges of the fifth somite are acute.

The single specimen of the oldest stage (No. 4) was so badly preserved that many points were obscure. It is shown in ventral view in Pl. XIII. fig. 7. The abdomen is wide and flat, the lateral edges of the carapace are folded in, and the basal process of the uropod is as long as the telson, which is deeply angulated on the middle line (Pl. XIII. fig. 8). The secondary single spine between the submedian and the intermediate is now much smaller than the latter, which has a minute spinule internal to its base. The raptorial claw is flat and oval as it is in the adult *Coronis*.

The striking resemblance which Claus points out between the early stages of this larva and a young *Alima* larva are superficial, since it is a true *Erichthus*, with the ocular and antennary somites covered by the rostrum, the carapace folded downwards and inwards at the sides, the outer spine of the basal prolongation of the uropod longer than the inner, and only one instead of several secondary spines between the submedian and the intermediate spines of the telson.

While there are numerous specific differences between it and the larva of *Coronis excavatrix*, a comparison of the various stages in the development of the two larvæ will show their very close similarity, and there can be no doubt that this also is a *Lysiosquilla*, and it probably belongs to the subgenus *Coronis* also.

Claus figures several advanced larvæ which agree with this one in the depression of the hind body, the number and relative size of the marginal spines on the telson, the

	No. 1.	No. 2.	No. 3.	No. 4.	No. 1.	No. 2.	No. 3.	No. 4.
Measurements *on middle* line :—								
Rostrum from tip to anterior edge of ocular somite,	·80	1·04	1·25	1·99	192	197	193	195
From anterior edge of ocular somite to tip of labrum,	·32	·41	...	·75	77	77	...	73
From tip of labrum to posterior edge of carapace,	1·12	1·44	2·50	2·49	269	272	385	244
From posterior edge of carapace to posterior edge of telson,	1·92	2·40	2·74	4·93	462	454	422	488
Total length on middle line,	4·16	5·29	6·49	10·21	1000	1000	1000	1000
Width of carapace between bases of postero-lateral spines,	...	...	...	2·16	...	...	...	...
Width of fourth abdominal somite,	...	...	...	1·76	...	...	...	...

shape and character of the uropod, the width of the raptorial claw, the position of the postero-lateral spines of the carapace and other features, and as he has also been able to show that the dactylus of the raptorial claw of the older larvæ is bordered by

numerous marginal spines, there is little doubt that they are *Lysiosquilla*, pretty closely related to the two which have been described. One of these, an *Erichthus* 14 mm. long, from Bengal,[1] he himself refers to the subgenus *Coronis*,, and his *Squillerichthus triangularis* (fig. 13) and possibly his *Erichthus latreillei* (fig. 18) are closely related species.

The Challenger collection contains many specimens of a number of species of this larval type, some of them very broad and short, and others as narrow as a *Gonodactylus Erichthus*, from which they are distinguished by the position of the postero-lateral spine of the carapace, which is either on the ventral edge or nearer to it than to the dorsal middle line, while the reverse is the case in the *Gonodactylus* larva, which also has its hind body convex instead of flat.

One of these *Lysioerichthus* larvæ from a surface collection made by the Challenger at Papua, Japan, is shown in Pl. XI. figs. 10, 11, 12, and 13. It is $\frac{9}{10}$ of an inch long on the middle line, with a minute dorsal spine, a rostrum which is nearly as long as the carapace, small antero-laterals, and postero-laterals which spring from the carapace close to its ventral edge, and reach backwards as far as the middle of the sixth abdominal somite, while all the abdominal somites except the first are exposed on the middle line. The raptorial claw (fig. 13) is flat, broad and oval, and its dactylus shows under the cuticle traces of eight marginal spines. The hind body is as wide as the carapace, and the telson (fig. 11) is much wider than long, with its posterior border angulated and fringed with numerous small spinules between the submedians, the distance between which is about half the greatest width of the telson. There is a small spinule internal to the base of each lateral and each intermediate marginal spine, and one small secondary spine between the intermediate and submedian.

Length of carapace including rostrum,	·48 inch.
Length of exposed somites and telson,	·42 „
Total length on middle line,	·90 „
Length of postero-lateral spines,	·26 „

The oval shape of the flattened carpus indicates that this larva is a *Coronis*. There is a general resemblance between it and the one last described, but the raptorial claw is less oval, and in a third closely related larva, collected between Sydney and Wellington, the raptorial claw is still more elongated. This latter larva, which is shown in Pl. IX. figs. 6, 7, 8, 9, and 10, is so similar to the one shown in Claus's figure 20, that they must represent related adults, and I am therefore compelled to dispute his identification of his larva as a young *Gonodactylus*.

It is remarkable for the great length of the rostrum and postero-lateral spines, the

[1] Metamorphose der Squillïden, fig. 19.

latter reaching beyond the tip of the extended telson. The carapace has a long median dorsal spine, and it exposes the posterior half of the third abdominal somite.

Length of carapace on middle line including rostrum, . .	·50 inch.
Length of exposed hind body, ...	·20 „
Total length from tip of broken rostrum, . . .	·70 „
Length from tip of rostrum to tip of postero-lateral spines, . .	·78 „
Width of carapace between bases of postero-lateral spines, . .	·26 „
Width of hind body, ...	·16 „

In addition to the larvæ which have been described, the Challenger collection contains numerous specimens from various localities, which must represent closely related adults. It also contains specimens of two somewhat peculiar larval types, which join to their distinctive characteristics so many features which are shared by all the *Lysioerichthus* larvæ that I place them in this group.

One of them, which is represented by several specimens from Rio Janeiro, is shown in profile view in Pl. IX. fig. 11, and in dorsal view in Pl. XI. fig. 6, while the telson, the raptorial claw, and the seventh thoracic limb are shown in figures 7, 8, and 9. It is a little younger than Claus's *Squillerichthus triangularis*,[1] but it belongs to the same or a closely related adult. The dactylus of the raptorial claw of the oldest specimen in the Challenger collection is smooth, but in Claus's larva six marginal spines were visible underneath the cuticle. This, as well as the width and flatness of the hind body, the depth of the carapace, and the ventral infolding of its lateral edges, and the shape of its telson and uropods (fig. 7) show its close relationship to the *Lysioerichthus* larvæ which have already been described, and the flat oval raptorial claw (fig. 8) and the dilated oval scale-like form of the appendages to the exposed thoracic limbs of the older larvæ (fig. 9), indicate that the adult is one of the lower or *Coronis*-like species of the genus *Lysiosquilla*. In Claus's larva, which is slightly more advanced than the oldest one in the Challenger collection, the raptorial claw exhibits under the cuticle indications of six marginal spines, and this author therefore regards it as the young of one of the six-spined species of *Squilla* (p. 131). The fact that the young *Lysiosquilla excavatrix* has a smaller number of marginal spines than the adult male, shows that the presence of six spines in the larva is no evidence that they are not more numerous in the adult, and while it is true that most of the adult *Lysiosquillæ* have more than six spines, and that some of them have less, there are several species in which the adult has only six. Claus says (p. 131) that the telson of this larva exhibits the *Squilla*-type, but as all known species of *Squilla* and all the *Alima* larvæ have numerous secondary marginal spines between the submedian and intermediate marginal spines of the telson, while our specimens, as well as the one figured by Claus, have only one such secondary spine, its relationship is obviously with *Lysiosquilla* rather than *Squilla*.

[1] Metamorphose der Squilliden, fig. 13.

A second very remarkable larva, characterised by the great elongation of all the spines of the carapace, especially the antero-laterals, I refer, with less confidence, to the *Lysioerichthus* group. The single specimen, which is shown in Pl. XI. fig. 14, was taken in the tow-net off Kandavu Island, Fiji.

Lysiosquilla maculata (*Erichthus duvaucellei*) Guérin.—The largest *Erichthus* in the Challenger collection is shown in profile in Pl. X. fig. 7, and from below in Pl. XI. fig. 4. The collection contains numerous specimens which differ from each other only in the length of the dorsal spine, which is often entirely absent, sometimes present but very short, and occasionally well developed, as in the specimen from which fig. 7 was drawn. The various specimens are so much alike in all other particulars that I cannot believe that the length of this spine can be taken as an index of specific identity. It is probable that in the older larva at least it is often broken off in moulting, and that the differences in its length are accidental.

The largest specimens, which are more than one inch long, were collected between Api and Cape York, between Admiralty Island and Japan, in the Straits of Mendino, and at other points in the West Pacific. It is apparently the same as the *Erichthus duvaucellei* which Guérin obtained in the Gulf of Bengal, and Claus in the Indian Ocean. Although Claus states (p. 135) his opinion that it is a *Squilla* larva, it is clearly a *Lysioerichthus*, closely related to the various larvæ which have been described. In the larger specimens the integument of the carapace and of the abdominal somites is soft, flexible and leather-like, as in *Lysiosquilla maculata*, and the edges of the somites of the hind body exhibit the transverse dark bands which are so characteristic of this species. The inner spine of the basal prolongation of the uropod is longer than the outer, a relation which is somewhat exceptional among the *Lysioerichthus* larvæ, and also among the adult *Lysiosquillæ*, although the adult *Lysiosquilla maculata* is one of the exceptional species, having the inner spine longer than the outer. The raptorial claw of the larva is long and slender, with traces under the cuticle of eight marginal spines, and as the adult female *Lysiosquilla maculata* has seven or eight, while this number is increased in the adult male to nine or ten, I cannot doubt that this large, flat, soft, transversely striped, widely distributed larva, is the young of the largest of the Stomatopoda, *Lysiosquilla maculata*, which is also flat, transversely striped, soft, and very widely distributed.

The Larva of the genus Coronida.

I have shown that we are led by the comparative study of the adult Stomatopoda, to believe that *Lysiosquilla* and *Squilla* are the divergent descendants of a *Protosquilla*-like form, with an acutely pointed rostrum, and minute uropods, and with the base of the dactylus of the raptorial claw dilated as in *Protosquilla* and *Gonodactylus*, but armed with marginal spines, and with the hind body depressed as it is in *Squilla* and *Lysiosquilla*,

and with a wide telson with the marginal spines on its posterior edge. For this genus I have proposed the name *Coronida*, and I have shown that we are acquainted with two species which are to be referred to it. If this phylogenetic generalisation be correct, we should expect the larva of this genus to unite in itself characteristics of both *Alima* and *Erichthus*, and to stand in somewhat the same relation to them as that which the adult *Coronida* bears to *Lysiosquilla* and *Squilla*. We should expect it to be a stem-form from which both of these larvæ may be derived. The Challenger collection contains no larvæ of this character, and so far as I am aware only a single specimen has been observed. This remarkable and interesting form, from the Atlantic, is shown in Claus's figure 14. It is much more advanced than any other *Erichthus* or *Squillerichthus* larva which has ever been described, resembling in this respect an *Alima* larva, and like the advanced *Alima* larvæ it has well developed gills, a long annulated flagellum on the second antennæ, a mandibular palpus, and its first five pairs of abdominal feet are, like those of the *Alima*-larva, more perfectly developed than in *Erichthus*, and it resembles all *Alima* larvæ and differs from all *Erichthus* larvæ in the presence of numerous (twelve) secondary spines between the intermediate and submedian spines of the telson. Like all *Alima* larvæ, and the young and a few of the old *Lysiosquilla Erichthus* larvæ, the lateral edges of the carapace are fringed with spines, but these edges are folded downwards and inwards, and in all other respects it is an *Erichthus*. The many points in which it resembles *Erichthus* and differs from all *Alimæ*, joined to many other points of resemblance to *Alima* and difference from all *Erichthi*, render it peculiarly interesting. It is so far advanced that it undoubtedly assumes its adult form after the moult which follows the stage shown in Claus's figure, and the adult rostrum with a long acute median spine is visible under the cuticle. As it has a wide flat hind body and spines in the dactyle it is not a *Protosquilla*, or a *Gonodactylus*, or a *Pseudosquilla*, and the long spine on the rostrum shows that it is neither a *Squilla* nor a *Lysiosquilla*. The telson is wider than long, its marginal spines are crowded backwards, the figure indicates that the sixth abdominal somite is probably fused with the telson, and the uropods are very small, and the two spines are very small and equal.

All its characteristics indicate that it is a very primitive and synthetic type, and while it may possibly belong to an unknown genus, all the indirect evidence which it furnishes indicates very strongly that it is either the larva of *Coronida*, or else of some closely allied form. I propose for it the provisional generic and specific names *Erichthalima synthetica*.

Pseuderichthus and the Metamorphosis of Pseudosquilla.

Claus has traced to the adult *Pseudosquilla* a long narrow *Erichthus* larva which differs from *Lysioerichthus* in the shape of the carapace, which is narrow and short, and

also in the great length of the narrow hind body. His collection contained numerous specimens, all very similar in general appearance to the one which he traced to its adult form, from various localities in the Indian and Atlantic Oceans. They are all narrow and elongated and from 16 to 42 mm. long.

The Challenger collection also contains numerous specimens from many widely separated localities; all so similar to the one which Claus studied that they must pertain to closely related adults, and I therefore place them all in a provisional genus *Pseuderichthus*. One of them $1\frac{12}{100}$ inches long, from a collection made between Tenerife and St. Thomas, is shown in dorsal view in Pl. XII. fig. 6, while various parts of its body, more highly magnified, are shown in Pl. VI. figs. 2 and 6, and Pl. XIII. figs. 12 and 14. The telson and uropods of a very similar but much larger specimen, $1\frac{3}{4}$ inches long, from Volcano, are shown in Pl. VI. fig. 7. Another much smaller species, which undoubtedly belongs in the same group, although it is much wider and flatter than the one figured above, is shown in side view in Pl. V. fig. 4. It is $\frac{24}{50}$ inches long, and is from a gathering made between Api and Cape York. In all the older larvæ of this group the submedian spines of the telson are very long and slender, and are tipped with movable spinules, as in the adult *Pseudosquilla;* the proximal joint of the exopodite of the uropod is bordered by numerous (six to twelve) spines, the terminals are much longer than the others, and the dactylus of the raptorial claw often exhibits traces of two or three marginal spines under the cuticle. As all these characteristics are features of resemblance to the adult *Pseudosquilla*, and as Claus has obtained a very complete series of stages connecting one of these larvæ with an adult of this genus, there can be little doubt that they are all *Pseudosquilla* larvæ.

While it is very closely related to both *Lysioerichthus* and the *Erichthus* of *Gonodactylus*, and united to both these larval types by intermediate larval forms, I believe the following features may be relied upon as diagnostic of the *Pseuderichthus* larva. It is distinguished from the *Lysioerichthus* by the position of the postero-lateral spines of the carapace, which are near the dorsal surface; by the narrowness of the carapace, which is at least twice as long as wide, shallower than in *Lysioerichthus*, and not at all, or only very slightly, infolded along its lateral edges; by the elongation of the hind body, the length of the submedian spines of the telson, the presence of numerous spines on the outer edge of the proximal joint of the exopodite of the uropod, and the very great elongation of the outer one of the two ventral spines on its basal joint. It is distinguished from the *Erichthus* of *Gonodactylus* by the fact that the postero-lateral spines of the carapace are short, usually only one-fourth or one-third as long as the carapace, while they are usually more than half as long in the *Gonodactylus* larva, and also by the fact that the rostrum is usually short and compressed, and armed at about the middle of its ventral edge by a large acute curved spine, in front of which there are often two or three smaller spines.

The adult genus *Pseudosquilla* is not sharply limited, as the various species are very closely related to *Gonodactylus* on the one hand, and to *Coronida* and *Coronis* on the other, and we should not expect the larval type to be more definite than the adult, and as a matter of fact the collection contains larvæ which closely resemble *Pseuderichthus* although they may possibly be *Gonodactylus* larvæ, and others which may possibly be *Lysiosquilla* larvæ.

The Challenger collection contains very few young larvæ of this type, and I have not been able to trace its metamorphosis, although Claus has given reasons for believing that it hatches as an *Erichthoidina*, and afterwards undergoes a retrograde metamorphosis, loosing and afterwards redeveloping all the thoracic appendages, except the first and second pairs.

The *Erichthoidina* from St. Vincent, shown in Pl. XII. fig. 3, may possibly be a young *Pseudosquilla*, although it more closely resembles the *Gonodactylus Erichthus*.

The Gonerichthus larva and the Metamorphosis of Gonodactylus.

The last larval type which I shall discuss is represented in the Challenger collection by numerous specimens, a few of which I have selected and drawn.

One of these, from St. Vincent, is shown in Pl. XII. fig. 5, while the telson and uropods of another specimen, from the Celebes Sea, in the same stage of development, and belonging to the same or a closely related species, are shown in Pl. XIII. fig. 9. The fully grown larva, $1\frac{25}{100}$ inches long, of another species from the West Pacific, lat. 17° 29′ N., long. 141° 21′ E., is shown in profile in Pl. XV. fig. 11, and from above in fig. 6, and the telson and uropods of a closely related species $1\frac{1}{5}$ inches long, from Volcano Island, in the West Pacific, are shown, more enlarged, in fig. 7.

The carapace of another species, $\frac{60}{100}$ inch long, from the Celebes Sea, is shown in Pl. XV. fig. 1, and the telson of a young *Gonodactylus* of the *Chiragra* type in the adult condition is shown in Pl. XVI. fig. 5. This specimen, which is $\frac{9}{10}$ inches long, was taken with the trawl in 18 fathoms, west of the Philippine Islands, at Station 208. This latter specimen had the raptorial claw fully developed, and it exhibited all the characteristics of the adult *Gonodactylus*. It is certainly a young *Gonodactylus* closely related to, or possibly a specimen of, *Gonodactylus chiragra*, and a comparison of its telson and uropods with those of the various larvæ which have just been noticed will show that there is the closest agreement in every particular. In all of these larvæ, as in the young *Gonodactylus*, the sixth abdominal somite has a pair of submedian spines near its posterior edge, and its postero-lateral angles are produced into acute spines. The telson is slightly wider than long, its submedian spines are long and slender, but shorter than they are in *Pseuderichthus*, and without the movable spinules of the latter. The telson is notched on the middle line, and there are from fourteen to twenty small secondary spinules on

its posterior edge, between the submedians. There is one small secondary spinule internal to the base of the lateral marginal spine, another internal to the base of the intermediate, and a third midway between this and the submedian. In figs. 7 and 8 as in the young *Gonodactylus* the outer edge of the proximal joint of the exopodite of the uropod is fringed by nine marginal spines, the terminal one longest, and the outer spine of the basal prolongation is much longer than the inner, but not as long as it is in *Pseuderichthus*. A comparison of the telson of the young *Gonodactylus* with that of the other larvæ which are figured in this paper, will show that none of them except those now under discussion exhibit this resemblance. The *Gonerichthus* larvæ which are here figured are all of them well advanced, and are furnished with large compound gills on their abdominal feet; this, together with the perfect development of their uropods, shows that they are nearly mature, and about ready to moult into the adult form, and as none of them exhibit any traces of marginal spines on the dactylus of the elongated slender raptorial claw, we may feel confident that the adults belong to a genus in which the dactylus is unarmed. It is not probable that a larval type which is so common pertains to an unknown adult genus; the larvæ are not *Protosquillæ*, as the sixth abdominal somite is well developed, and as they have no movable spinules on the tips of the submedian spines of the telson they are not *Pseudosquillæ*. The only remaining genus is *Gonodactylus*, and their structural characteristics all indicate that they are the young of species in this genus. Claus, who has figured two of these larvæ in his figures 21 A. and 21 A'. correctly refers them to *Gonodactylus* (p. 139) although he also refers to this genus two larvæ, figures 20 and 21 B. which are not *Gonerichthi* but *Lysioerichthi*, as he indeed suspects may be the case with the second one, 21 B.

The *Gonerichthus* larva may be distinguished from the *Lysioerichthus* by the shallowness of its carapace, which is not at all infolded, and by the position of its postero-lateral spines, which arise very close to the dorsal middle line. It is distinguished from the *Pseuderichthus* larva by the length of these spines, which are at least half as long as the carapace, and also by the fact that the telson is wider than long, and longer than the long outer spine of the uropod.

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PLATE I.

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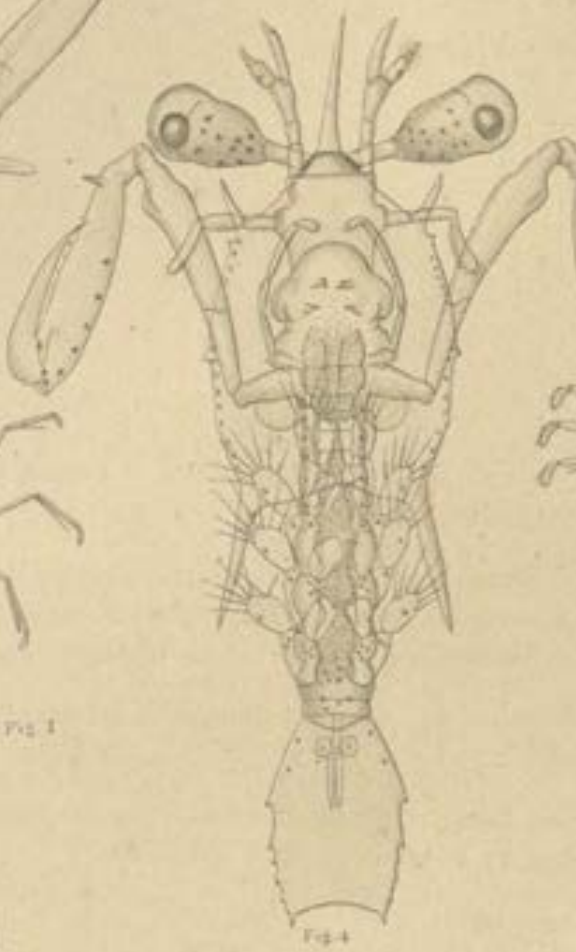

SQUILLA

PLATE II.

PLATE II.

SQUILLA (ALIMA).

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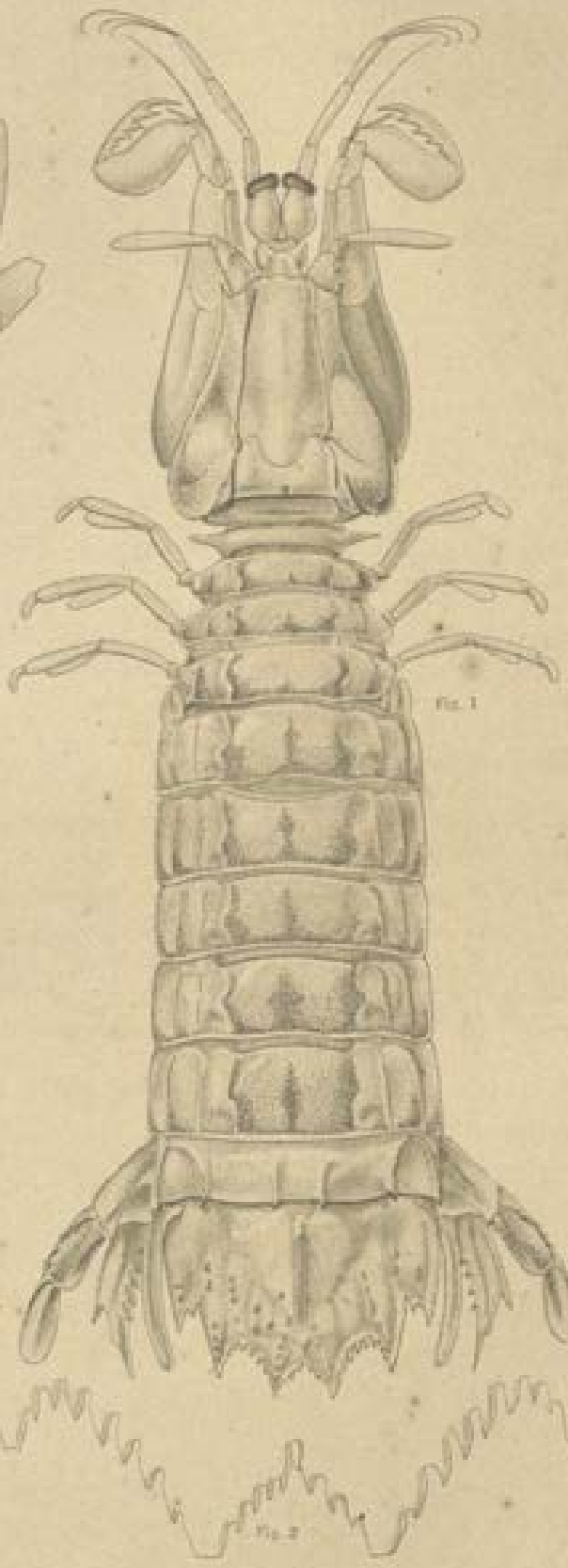

SQUILLA (ALIMA)

PLATE III.

PLATE III.

Squilla.

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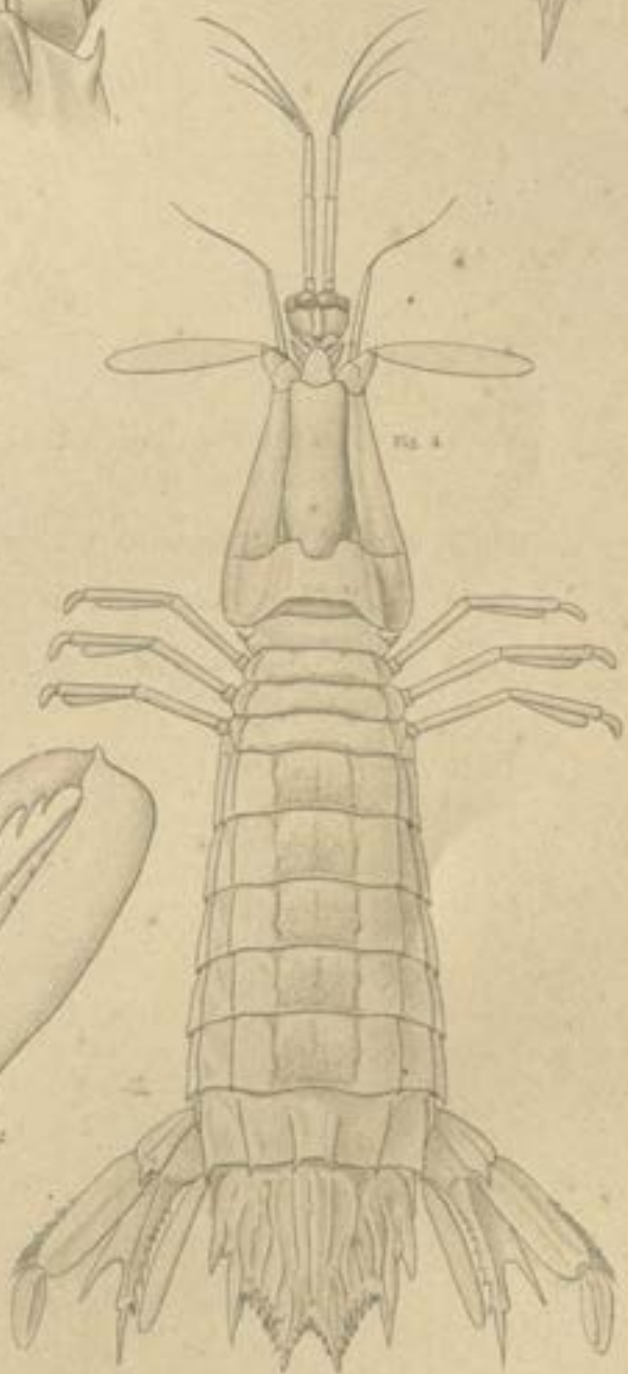

SQUILLA

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PLATE IV.

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Fig. 5. *Squilla* (*Alima*) *gracilis*, from St. Vincent. Stage No. 4, 11·54 mm. long.

Fig. 6. *Squilla* (*Alima*) *gracilis*, from St. Vincent. Stage No. 5, 17·38 mm. long.

Fig. 1.

Fig. 2.

Fig. 5.

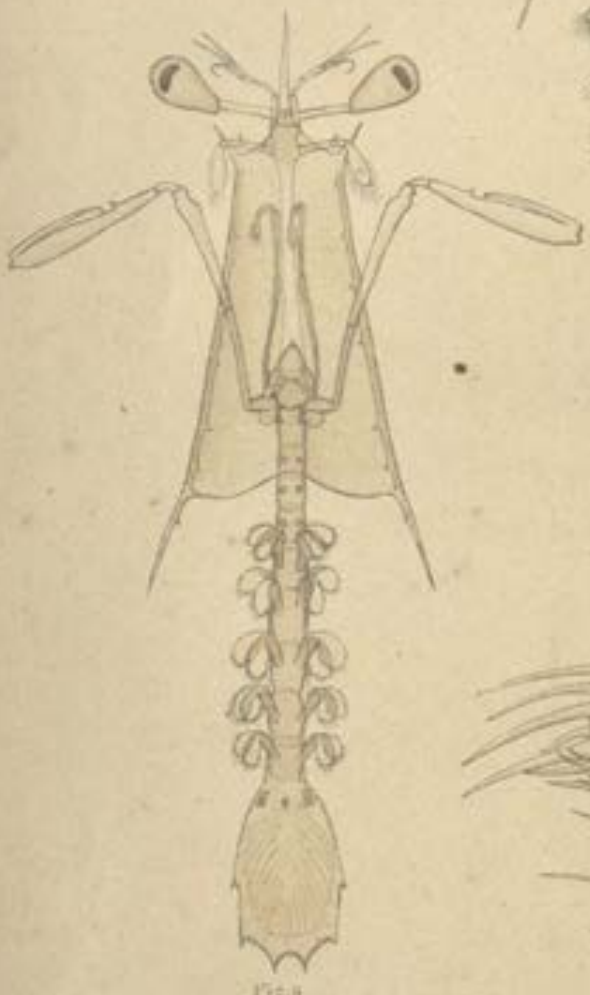

Fig. 6.

Fig. 3.

Fig. 4.

SQUILLA (ALIMA)

PLATE V.

PLATE V.

Fig. 1. First maxilla of the larva shown in fig. 5.

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Fig. 3. *Squilla* (*Alima*) *gracilis*, from St. Vincent. Stage No. 3; 9·18 mm. long (p. 84).

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Fig. 9. Telson of the larva shown in Pl. XII. fig. 2.

Fig. 4.

Fig. 1.

Fig. 2.

Fig. 9.

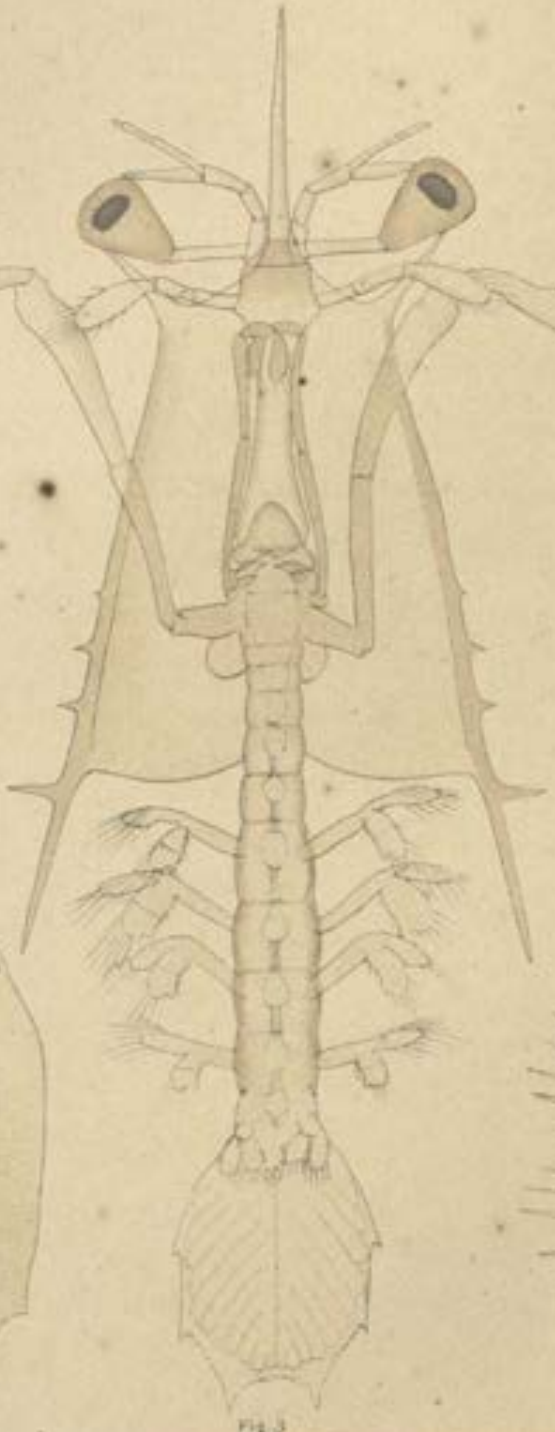

Fig. 3.

Fig. 5.

Fig. 7.

Fig. 6.

PLATE VI.

PLATE VI.

LYSIOERICHTHUS.

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Fig. 1

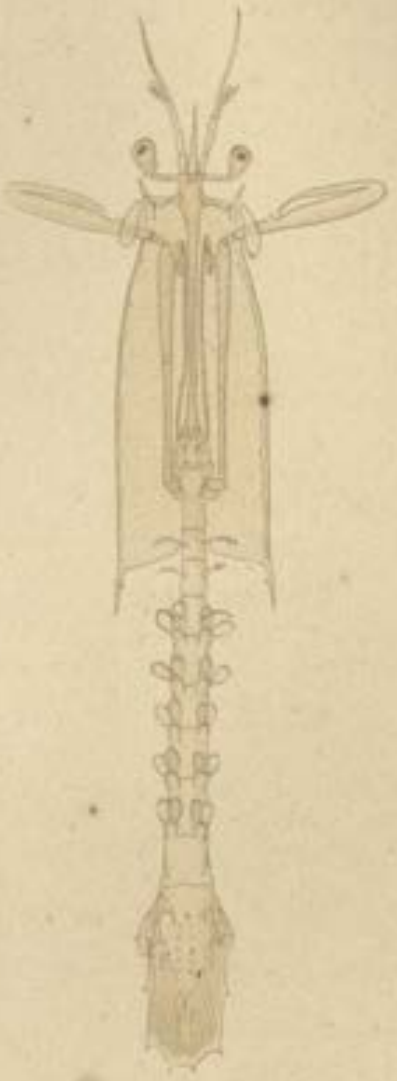

Fig. 2

Fig. 3

Fig. 4

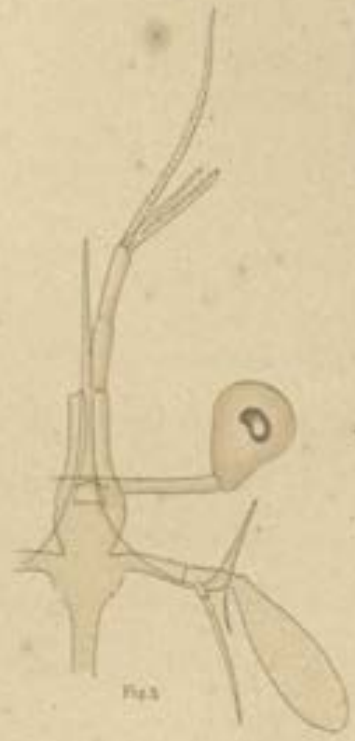

Fig. 5

Fig. 6

Fig. 7

LYSIOERICHTHUS

PLATE VII.

PLATE VII.

Squilla (Alima).

Fig. 1. *Squilla* (*Alima*) *macrophthalma*, from Cape Howe. Stage No. 2; 4·9 mm. long (p. 93).

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Fig. 3. *Squilla* (*Alima*) *macrophthalma*, from Cape Howe. Stage No. 4; 8·4 mm. long.

Fig. 4. *Squilla* (*Alima*) *macrophthalma*, from Cape Howe. Outline of telson of stage No. 1; greatly magnified.

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SQUILLA (ALIMA)

PLATE VIII.

PLATE VIII.

Squilla (Alima).

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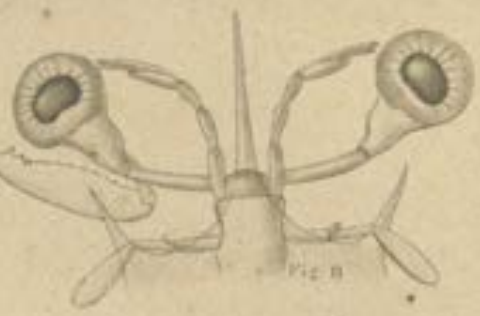

SQUILLA (ALIMA)

PLATE IX.

PLATE IX.

SQUILLA (ALIMA) (ALIMERICHTHUS) (LYSIOSQUILLA) LYSIOERICHTHUS.

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Fig. 3. *Alimerichthus*, 15·52 mm. long, from the South Atlantic.

Fig. 5. Telson and uropods of a younger *Alimerichthus*; 8·715 mm. long.

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Fig. 7. Telson and uropods of same larva.

Fig. 8. Telson and uropods of a younger specimen.

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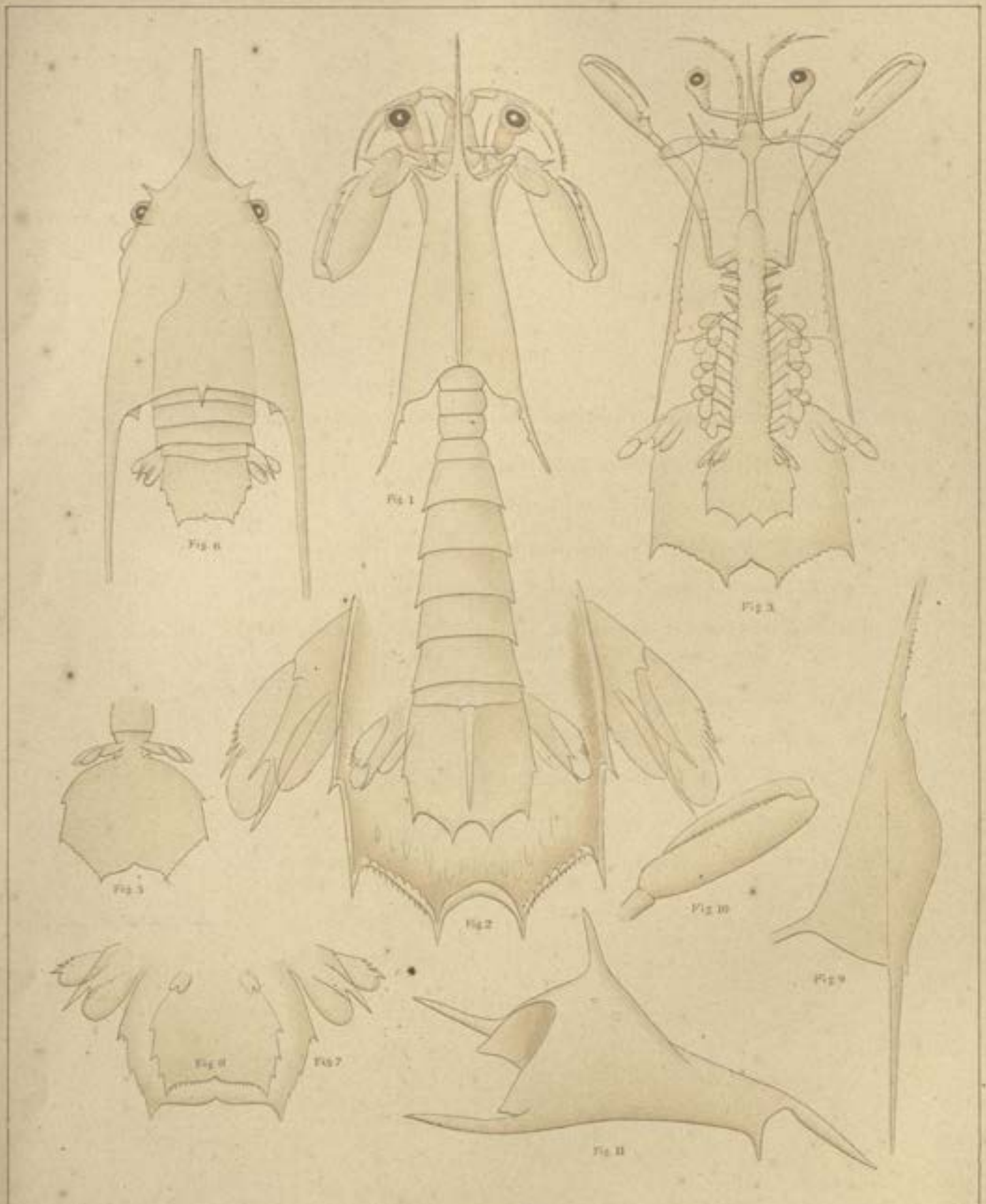
Fig. 10. Raptorial claw of the same larva.

Fig. 11. *Lysiosquilla* (*Lysioerichthus*) *triangularis*, from Rio Janeiro.



SQUILLA (ALIMA) ALIMERICHTHUS)
(LYSIOSQUILLA) LYSIOERICHTHUS

PLATE X.

PLATE X.

(LYSIOSQUILLA).

Fig. 1. *Lysiosquilla maculata.* Raptorial claw of male; one-half natural size (p. 45).

Fig. 2. *Lysiosquilla maculata.* Raptorial claw of female; one-half natural size.

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Fig. 4. *Lysiosquilla maculata.* First maxilla.

Fig. 5. *Lysiosquilla maculata.* Second maxilla.

Fig. 6. *Lysiosquilla maculata.* First abdominal appendage of adult male; slightly enlarged. *e*, exopodite; A, basal joint of endopodite; B, terminal joint of endopodite.

Fig. 7. *Lysiosquilla* (*Lysioerichthus*) *maculata;* magnified 5 diameters.

Fig. 8. *Lysiosquilla* (*Coronis*) *excavatrix*, n. sp.; male, magnified 2 diameters.

Fig. 9. *Lysiosquilla* (*Coronis*) *excavatrix.* First maxilla.

Fig. 10. *Lysiosquilla* (*Coronis*) *excavatrix.* Second maxilla.

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Fig. 12. *Lysiosquilla* (*Coronis*) *excavatrix.* Endopodite of first abdominal appendage of adult male; greatly enlarged (reference letters as in fig. 6; and, in addition, *a*, outer lobe; *b*, inner lobe; *c*, suture; *d*, retinaculum; *e*, fixed limb; *f*, movable limb of petasma).

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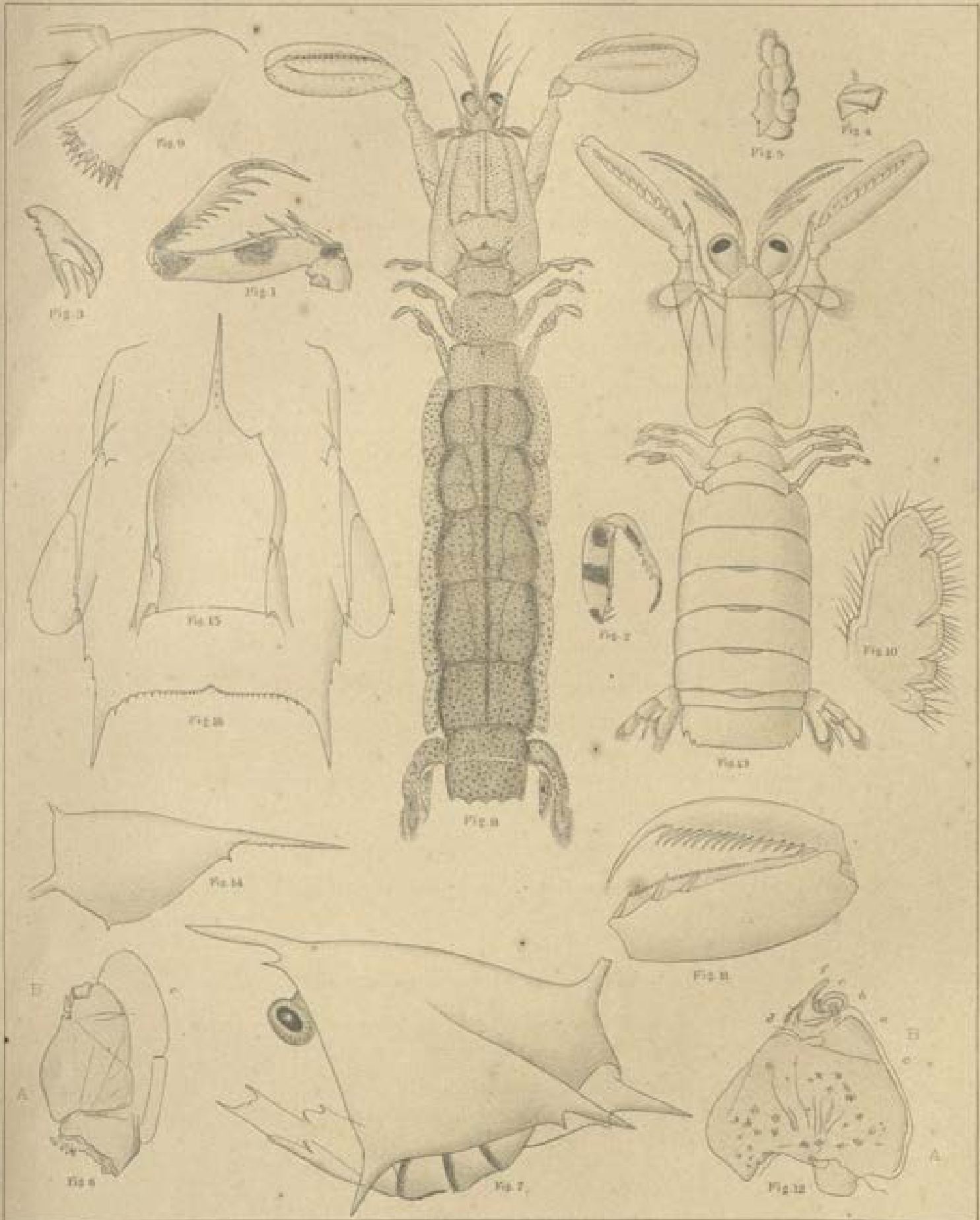
Fig. 16. *Lysiosquilla* (*Coronis*) *excavatrix.* Telson and uropods of the same larva, $\frac{8}{40}$ inch long, $\frac{7}{40}$ inch wide.



(LYSIOSQUILLA)

PLATE XI.

PLATE XI.

LYSIOERICHTHUS.

Fig. 1. *Lysiosquilla* (*Coronis*) *excavatrix*. Ventral view of a young *Erichthus* larva (*Erichthus multispinous*, Claus).

Fig. 2. *Lysiosquilla* (*Coronis*) *excavatrix*. Side view of same larva.

Fig. 3. *Lysiosquilla* (*Coronis*) *excavatrix*. Side view of older larva.

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Fig. 5. *Lysiosquilla maculata*. Marginal spinules of telson.

Fig. 6. *Lysiosquilla* (*Lysioerichthus*) *triangularis*, from Rio Janeiro.

Fig. 7. Telson and uropods of same.

Fig. 8. Raptorial claw of same.

Fig. 9. Seventh thoracic appendage of same.

Fig. 10. *Lysiosquilla* (*Lysioerichthus*), $\frac{9}{10}$ of an inch long, collected between Papua and Japan.

Fig. 11. Telson and uropods of same.

Fig. 12. Side view of carapace of same.

Fig. 13. Raptorial claw of same.

Fig. 14. *Lysioserichthus* (?), from Kandavu Island, Fiji.

Fig. 13

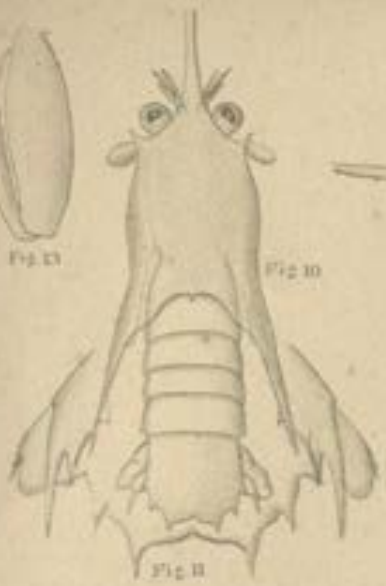

Fig. 10

Fig. 11

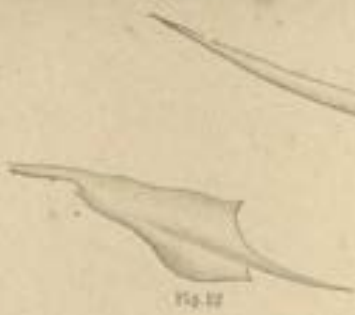

Fig. 12

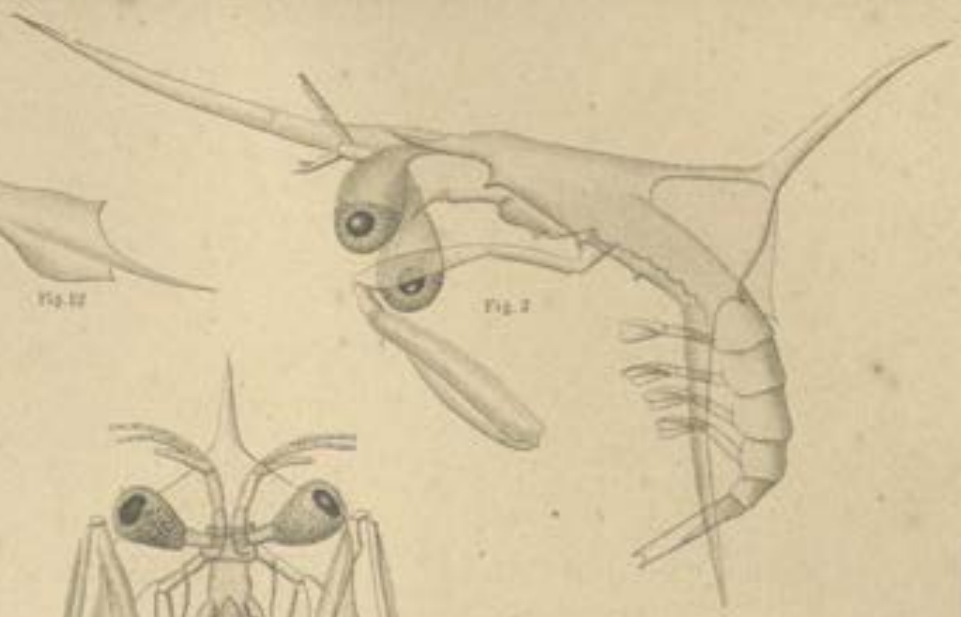

Fig. 2

Fig. 4

Fig. 5

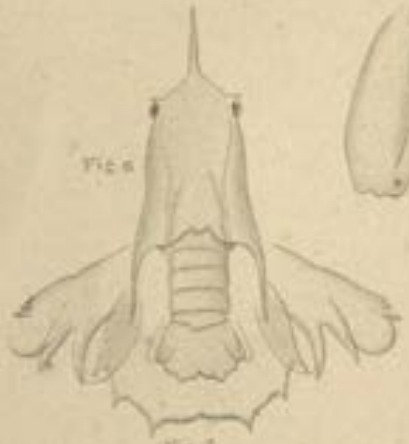

Fig. 6

Fig. 7

Fig. 8

Fig. 1

Fig. 9

Fig. 14

Fig. 3

LYSIOERICHTHUS

PLATE XII.

PLATE XII.

1–3. ERICHTHOIDINA. 4. LYSIOERICHTHUS. 5. GONERICHTHUS. 6. PSEUDERICHTHUS.

Fig. 1. *Erichthoidina* (*Lysiosquilla ?*), from Honolulu. Zeiss, A, 2.

Fig. 2. Older stage of same.

Fig. 3. *Erichthoidina* (*Gonodactylus ?*), from St. Vincent, Cape Verde. Zeiss, A, 2.

Fig. 4. *Lysiosquilla* (*Lysioerichthus*) *minutus*, from St. Vincent, Cape Verde. Stage No. 1; 4·16 mm. long.

Fig. 5. *Gonodactylus* (*Gonerichthus*), from St. Vincent, Cape Verd. Zeiss, A, 2.

Fig. 6. *Pseudosquilla* (*Pseuderichthus*), 1·14 inches long, collected between Tenerife and St. Thomas.

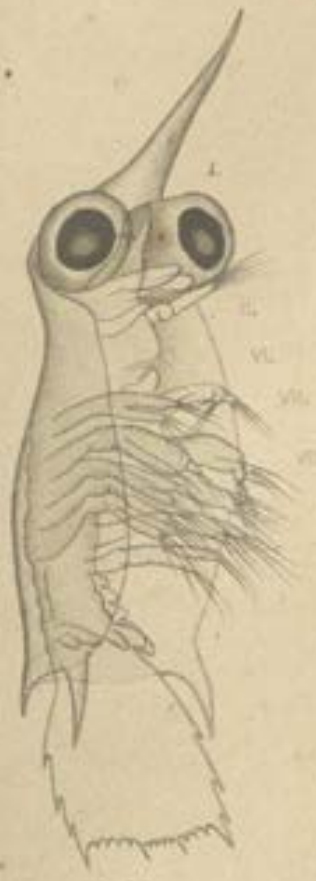

Fig. 2

Fig. 4

Fig. 6

Fig. 1

Fig. 3

1, 2 ERICHTHOIDINA 4 LYSIOERICHTHUS

3 GONERICHTHUS 6 PSEUDERICHTHUS

PLATE XIII.

PLATE XIII.

Squilla (Alima).

Fig. 1. *Coronis* (*Erichthus*) *minutus*, from St. Vincent. Hind body of the larva shown in Pl. XII. fig. 4, without the appendages (p. 105).

Fig. 2. Mouth parts of same larva.

Fig. 3. Telson of a slightly older larva. Stage No. 2; 5·20 mm. long.

Fig. 4. Antenna of same larva.

Fig. 5. Nervous system of same larva.

Fig. 6. *Coronis* (*Erichthus*) *minutus*, from St. Vincent. Stage No. 3; 6·46 mm. long.

Fig. 7. *Coronis* (*Erichthus*) *minutus*, from St. Vincent. Stage No. 4; 10·16 mm. long.

Fig. 8. Telson and uropods of same larva.

Fig. 9. Telson of a larva similar to the one shown in Pl. XII. fig. 5.

Fig. 10. Telson of the larva shown in Pl. V. fig. 4.

Fig. 11. Profile view of the carapace of the larva shown in fig. 3.

Fig. 12. Anterior end of the body of the larva shown in Pl. XII. fig. 6.

Fig. 13. Thoracic limb of same larva.

Fig. 14. Raptorial claw of the larva shown in Pl. XII. fig. 6.

Fig. 10.

Fig. 14.

Fig. 7.

Fig. 11.

Fig. 5.

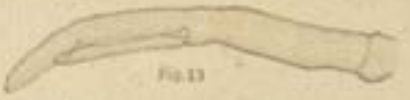

Fig. 13.

Fig. 4.

Fig. 6.

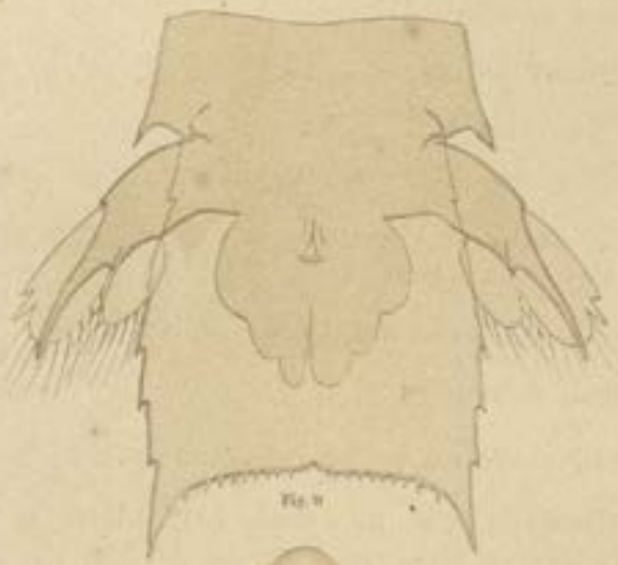

Fig. 9.

Fig. 1.

2

Fig. 3.

Fig. 8.

Fig. 12.

SQUILLA (ALIMA)

PLATE XIV.

PLATE XIV.

GONODACTYLUS. PROTOSQUILLA.

Fig. 1. *Gonodactylus graphurus* (Miers). Side view of a male specimen, $2\frac{14}{100}$ inches long, from Cape York (p. 58).

Fig. 2. *Protosquilla cerebralis*, n. sp. Side view of a female specimen, $1\frac{27}{100}$ inches long, from Fiji.

Fig. 3. *Protosquilla cerebralis*. Raptorial claw (p. 72).

Fig. 4. *Gonodactylus graphurus*. Dorsal view of sixth abdominal somite of a male specimen, with telson and uropods.

Fig. 5. *Gonodactylus glabrous*. Dorsal surface of sixth abdominal somite, with telson and uropods (p. 62).

Fig. 6. *Gonodactylus graphurus*. Anterior end of body, greatly enlarged.

Fig. 3

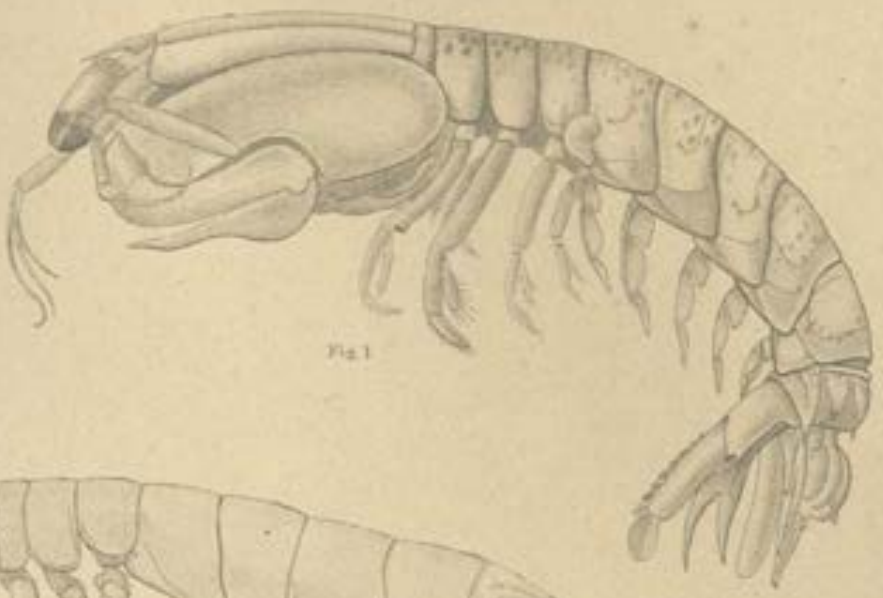

Fig. 1

Fig. 2

Fig. 4

Fig. 5

Fig. 6

GONODACTYLUS PROTOSQUILLA

PLATE XV.

PLATE XV.

GONODACTYLUS. PROTOSQUILLA.

Fig. 1. *Gonodactylus* (*Gonerichthus*). Carapace of a *Gonerichthus*-larva, $\frac{6}{10}$ inch long, smaller than the one shown in fig. 11, but older, from the Celebes Sea.

Fig. 2. *Protosquilla elongata*, n. sp. Dorsal view of a specimen, $\frac{77}{100}$ inch long, from St. Vincent (p. 67).

Fig. 3. *Gonodactylus graphurus*. Raptorial claw.

Fig. 4. *Gonodactylus chiragra*. Endopodite of the first abdominal appendage of a male specimen. A, distal joint; *a*, its outer lobe; *b*, its inner lobe; B, basal joint; *c*, *c*, suture; *d*, retinaculum; *e*, fixed limb of petasma; *f*, movable limb.

Fig. 5. *Gonodactylus* (*Gonerichthus*). Telson and uropods of the larva shown in fig. 1.

Fig. 6. *Gonodactylus* (*Gonerichthus*). Dorsal view of a *Gonerichthus*-larva, $1\frac{28}{100}$ inches long, from the West Pacific.

Fig. 7. *Gonodactylus glabrous*, n. sp. Dorsal view of a specimen, $2\frac{5}{100}$ inches long, from Samboangan Reef (p. 62).

Fig. 8. *Gonodactylus graphurus*. Petasma of a male specimen; reference letters as in fig. 4.

Fig. 9. *Gonodactylus glabrous*. First abdominal appendage of a male; reference letters as in fig. 4.

Fig. 10. *Pseudosquilla ciliata*. Endopodite of first abdominal appendage of a male; reference letters as in fig. 4.

Fig. 11. *Gonodactylus* (*Gonerichthus*). Side view of a *Gonerichthus*-larva, $1\frac{28}{100}$ inches long, from the West Pacific.

Fig. 12. *Protosquilla elongata*. Magnified view of the ventral surface of the telson of the specimen shown in fig. 2.

Fig. 1

Fig. 2

Fig. 3

Fig. 4

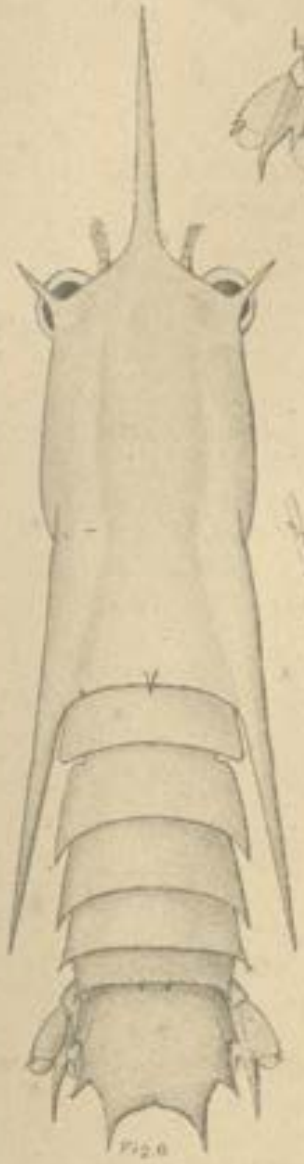

Fig. 5

Fig. 6

Fig. 7

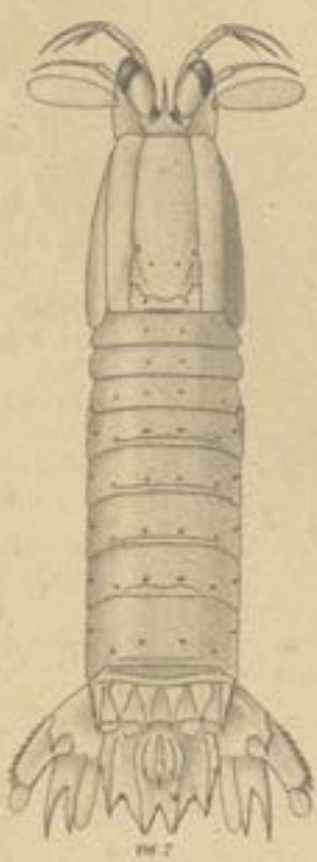

Fig. 8

Fig. 9

Fig. 10

Fig. 11

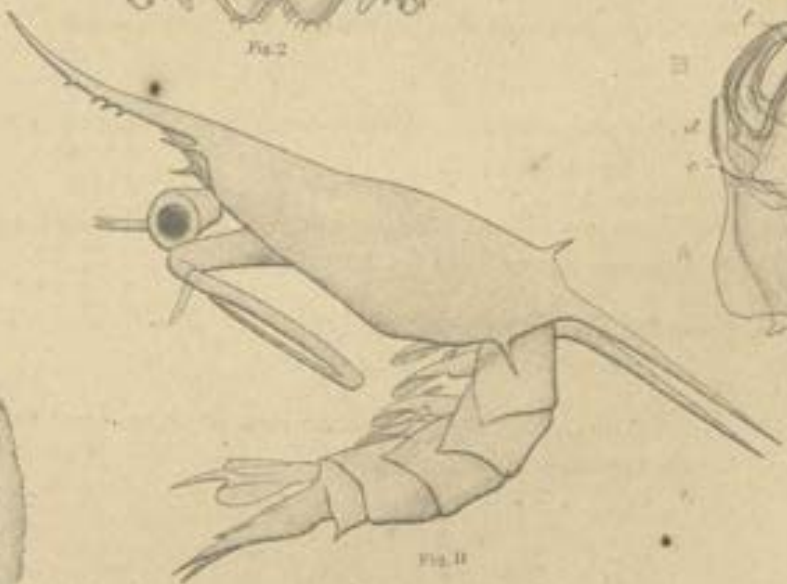

Fig. 12

GONODACTYLUS PROTOSQUILLA

PLATE XVI.

PLATE XVI.

PROTOSQUILLA.

Fig. 1. *Protosquilla guerinii* (White). Dorsal view of a female specimen, $1\frac{12}{100}$ inches long, from Honolulu (p. 75).

Fig. 2. *Protosquilla cerebralis*, n. sp. Dorsal view of a female specimen, $1\frac{27}{100}$ inches long, from Fiji (p. 72).

Fig. 3. *Protosquilla cerebralis*. Uropod of the specimen shown in fig. 3, from below.

Fig. 4. *Protosquilla elongata*. Anterior end of the body of the specimen shown in Pl. XV. fig. 2.

Fig. 5. *Gonodactylus*. Telson of a young specimen of a *Chiragra*-like species, from 188 fathoms, at Station 208, near the Philippine Islands.

Fig. 6. *Protosquilla guerinii*. Ventral view of the telson and uropods of the specimen shown in fig. 1.

Fig. 1

Fig. 4

Fig. 2

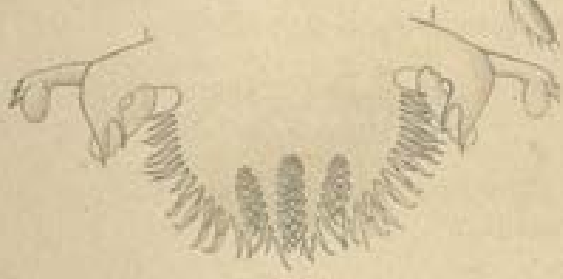

Fig. 6

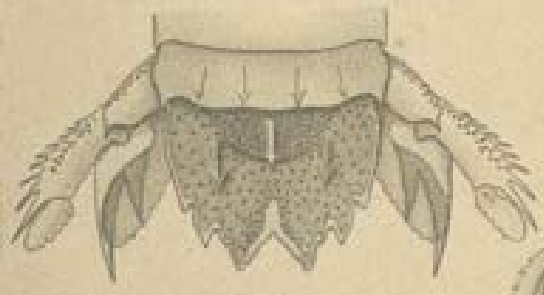

Fig. 3

Fig. 5

PROTOSQUILLA

THE

VOYAGE OF H.M.S. CHALLENGER.

ZOOLOGY.

REPORT on the Reef-Corals collected by H.M.S. Challenger during the years 1873–76. By John J. Quelch, B.Sc. Lond., late Assistant, British Museum; Curator of the British Guiana Museum, Georgetown, Demerara.

PREFACE.

Some years after the return of the Challenger Expedition, the Reef-Corals collected during the voyage were sent to the British Museum; being of a more or less fragmentary character, it was not at first proposed to publish any detailed Report on the collection. The specimens were placed in my hands for examination and identification, and as on the whole they proved to be of very great interest, the following short Report was prepared at the request of Mr. John Murray, to whom I desire to express my obligation for the opportunity afforded me of visiting several Continental Museums in order to examine types and named specimens of Corals.

The Report, it was agreed, was to be short, limited both in its text and in its plates; and indeed my engagements and the conditions under which the work has been accomplished would have made it necessarily of such a nature.

That the Report is incomplete in many respects no one can be more fully aware than myself; but, on the one hand, it must be stated that this was necessarily so, owing to the limitations under which it was permitted, while, on the other hand, the time at my disposal for its completion has been so repeatedly and seriously interrupted, that it has been almost with a feeling of despair that the work has been brought even to its present form. It is consoling, however, to reflect that even though it is incomplete, the report will yet form a small contribution to our knowledge of the distribution of the Reef-Corals.

To Dr. Günther, F.R.S., my thanks are especially due, since it was at his direction that the examination of the Reef-Corals was undertaken, and owing to his kindness that an account of them was possible.

To Professor Perrier and Monsieur Poirier of the Museum of Natural History, Paris; to Dr. de Mann, late of the Leyden Museum, and to Professor von Martens of the University of Berlin, I am indebted not only for every assistance while engaged in the examination of the collections under their charge, but also for much personal kindness.

To Mr. R. Etheridge, sen., F.R.S., to Professor P. Martin Duncan, F.R.S., and especially to Mr. S. O. Ridley, M.A., I am indebted for much information and assistance on various points; while to Professor Moseley I am under obligation not only for suggestions of different kinds, but for assistance which I have derived from his published Notes by a Naturalist on the Challenger, in giving an account, where possible, of the conditions under which the Corals flourished on the reefs.

The plates have been drawn under my constant supervision, and I should like to make a special acknowledgment of the great pains which the artist, Mr. Gawan, has taken with them, and of the skill which he has brought to bear on them.

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INTRODUCTION.

ON THE REEF-CORALS DESCRIBED.

The Reef-Corals here described belong almost entirely to the Reef Madreporaria; the remainder consisting of a few Millepores. With the more distinctive reef-forms have been included, for the sake of completeness, a few other species which were either dredged in rather deep water or were obtained from localities where no reefs existed. The term Reef-Coral, it must be confessed, is becoming rather vague in its signification; since a true reef-building species may be found either in its reef-forming position, or in quite deep water, or in shallow water where no reefs are found. And while on the one hand many genera are characteristic of shallow water and the reef fauna, or of the deep sea, yet there are, on the other hand, many which are common to both; and it is probable that extended investigation will increase the number of these at the expense of the former.

The collection of Reef-Corals made was a large and an important one, there being representatives of two hundred and ninety-three species, referable to sixty-nine genera; and many of the species are represented by series of specimens which often present a considerable degree of variation.

The new species amount to one-fourth of the total number of species obtained, a result that is scarcely to be wondered at, considering the little that is known of the Corals of the vast number of Pacific and Indo-Pacific Islands. Of the seventy-three new species, seventy-one were obtained in the Pacific, and two in the Atlantic; and this illustrates fairly well the comparative knowledge that we have of the two chief coral regions.

Of the sixty-nine genera represented in the collection, eight are new, the specimens on which they were founded being all obtained from the Pacific—a fact that is again extremely suggestive as to our want of knowledge of the coral fauna of that immense region.

It is perhaps advisable to notify here that in the distributional section, as well as in the above statements, the terms "new species" and "new genera" are applied to all forms made known by the Challenger, independently of the fact that some of these forms have been already described in a preliminary notice of the Challenger Reef-Corals, of which Part I. alone was published—the remainder being suppressed, as it was expected at that time that the Report would speedily be ready for the press.

No attempt has been made to give an account of the soft parts of the specimens which were preserved in spirit; for, apart from the consideration of want of time in which to carry out work of such a protracted nature and of such special difficulty, the circumstances and conditions under which the Report was written effectually prevented any such attempt being made. These specimens, however, were comparatively few in number, and moreover did not form part of the collection which was placed in my hands for examination. A systematic examination of them was nevertheless made, and the results incorporated in the Report.

Special attention must be called to the fact that the descriptions of the species apply to a specimen in which the calicles are perfect—a remark of much deeper significance than may appear. Owing to the fragile nature of many of the Corals, and more especially of their delicate septa, it is often an extremely difficult matter to prevent fracture of many of the parts. This is especially applicable to those species in which the septa are delicate and exsert; and about which there may be an entire misconception owing to injury of these parts. In many of the delicate specimens in the collection more or less considerable injury has taken place, which, however, has scarcely affected the more sheltered calicles in depressions of the surface or between the branches; and from these uninjured or less injured calicles the descriptions have been framed. A special case may be cited with reference to the genus *Galaxea*, in which species differ from each other notably in the exsert nature of the septa and in the prominence of the costæ. The degree of exsertness of the septa and of the prominence of the costæ may be considerably interfered with by a small account of friction, and on the most exposed parts of the corallum it will in many cases be found that it is impossible to find an accurately shaped calicle. This is clearly evidenced in two new species of the genus in the collection, *Galaxea aspera*, and *Galaxea fragilis*. In the figures that are given of the corallum, natural size, the species in each case is represented as it occurs in the collection in its injured state; the real structure, as determined by a close examination of the less injured calicles, is shown approximately by a figure of a restored calicle.

As the number of plates was by request to be limited, only the new forms have been figured; and in nearly every case only a small portion of the corallum, natural size, has been represented to show the general character. The description of the species supplies the habit of the form; and to possess the complete figure it is only necessary to amplify the portion figured to the stated shape and size. For all essential purposes of identification, the portion figured is believed to be sufficient when taken with the various magnified views. Had each new species been figured to show the natural size of a characteristic specimen, with the additional magnified details, and had all the previously described species, of which no satisfactory figure exists, been also represented, the number of plates must have been increased at least tenfold.

No complete re-descriptions of previously described species are given, but in all cases

where the specimens in the collection differ from the descriptions of the typical specimens, such differences have been noted; and where additional characters or interesting varietal forms are present, these are described often at considerable length. Re-examination and re-description of many of the old scattered type specimens are urgently required, and when these are forthcoming it is likely that some of the forms referred to old species, to which they present decided likeness, though differing in many stated particulars, will be found to be sufficiently characterized to be ranked as distinct species. Of the generic grouping of the large number of species described by Dana in his great work on the Zoophytes of the United States Exploring Expedition, the valuable revised list by Verrill, published in Dana's Corals and Coral Islands, is taken as the scheme; exception being made, however, in one or two instances in the revised specific determination. Revised specific *descriptions* with figures, however, are urgently needed of many of these forms.

Detailed synonymy of the species described by the old authors has not been given, since it has already been given at length by Milne-Edwards and Haime in their classical work, Histoire naturelle des Coralliaires; more modern synonyms of different species have been mentioned or indicated, however, in those cases where the synonymy is obvious.

Besides the reference to the description given by the author of the species, reference has been made in almost every case both to the re-description as given by Milne-Edwards and Haime in their great work, which thus serves as a handbook of reference for the species of the old authors, and to those later works in which additional light is thrown on the characters and affinities of the older as well as of the more recently described species, while additional references are given to those works in which good figures of the species are to be found.

No priority is given in any case to manuscript names; the published descriptions being alone referred to.

ON DISTRIBUTION.

In the treatment of the distribution of the Reef-Corals, lists have been given of the species which were obtained at each locality, together with lists of the new species, and of the old species which are now recorded for the first time from each station; while an attempt has been made to furnish in each case a complete list of the recognised species now known to occur there.

In order to give some idea of the local conditions under which the Corals flourish on the reefs, quotations bearing on the point have been given in all cases, where possible, from the observations of Professor Moseley, as stated in each case; unfortunately, however, the information at hand gives little or nothing of the conditions or surroundings peculiar to individual species. For information of this kind to be of any value, detailed

observation and even experiment would be essential; and this was naturally out of the question owing to the short period of time passed at each reef-station by the Challenger.

In the compilation of the lists of the species which are known to occur at each of the Challenger reef-stations, published localities have been alone considered, and with this limitation it is believed that the lists are fairly complete as regards the more definitely marked reef-building forms. Considerable difficulty has been experienced, however, in deciding between various simple forms, which, although not among the usually recognised reef-builders, are yet either shallow-water forms or forms from the comparatively deeper waters of the reef-areas.

In the case of many of the species described or recorded by the older authors, though it is certain that many of them must occur at one or more of the stations named, yet it was impossible to incorporate them owing to the want of a definite record of the locality; while, on the other hand, in many cases it seems to me equally impossible to be certain, either from the figures or from the descriptions, what species were really intended.

Though the lists may possibly be found incomplete, yet it must be pointed out, particularly to those who have not full opportunity for consulting the whole literature on the subject, that the simple record of a species is not always sufficient for its location, that often a knowledge of its history is required. Of this, a case in point may be taken from the record given by Dana of the occurrence of *Fungia echinata*, Pallas, in the Fiji Islands. Specimens from the East Indies (Singapore) and from the Fiji Islands were referred to this species by Dana; but it has been shown by Milne-Edwards and Haime that the specimens were not referable to *Fungia echinata*, but to a new species *Fungia danæ*, which they also record from Manilla as well as from the East Indies and the Fiji Islands. Following on this, however, it has been shown by Verrill that, while the original Singapore specimens of Dana are forms of *Fungia danæ*, the Fiji specimens are distinct and belong to a new species, *Fungia lacera;* so that while lists from Dana or from Milne-Edwards and Haime would include *Fungia echinata* or *Fungia danæ* from the Fiji Islands, the fact is that neither of these species is as yet recorded from that locality, but only the *Fungia lacera*.

The detailed list of the species now known from each locality has been given, with the hope not only that it will prove of use to those who may be working at the Fauna of the island or groups of islands represented, but more especially that it may serve as a basis for, or as a first instalment to, a knowledge of the distribution of the Reef-Corals.

Little or no attempt has been made to generalize from the facts at hand as to the relations of the Fauna of the various groups, since it was impossible not to recognise how incomplete was the knowledge of them that we at present possess. Nor does it seem possible that such generalizations can safely be made until at least such examinations of the Coral fauna of the chief groups of the Pacific and Indian Oceans have been made as have been accomplished in the case of the Corals of the Red Sea.

Observations and experiments on individual species of Reef-Corals are sadly needed in order to bring to light the influences of local conditions upon them, such for instance as—

1. The nature of the surface on which they grow, when sandy, muddy, or rocky.
2. The stillness of the water in sheltered positions, or the motion of currents or running water in exposed positions.
3. The difference in temperature in different positions.
4. The presence or absence of direct sunshine.
5. The saltness or brackishness of the water.
6. The clearness or turbidity of the water.
7. The position on the reef, as to depth from the surface of the water.
8. The position on the reef as to proximity to or distance from the shore or the outer verge of the reef, &c.

It is certainly remarkable to notice the great amount of variation to which apparently one and the same species is liable, as is evidenced where large series of specimens are at hand; and it is probable that such variations are brought about by the influence of one or more of the above conditions. This to a certain extent seems borne out by the fact, observed by Professor Moseley at Bermuda, that certain species seem to thrive best in direct sunshine or in shade, or inside sheltered places like small caverns; from which it seems natural to conclude that the presence of less favourable conditions in each case would be attended with more or less marked changes in the growth of the species.

The reefs at Tahiti, Banda, and Bermuda seem to offer special facilities for the prolonged examination, both by observation and experiment, of individual species under varying conditions.

ON CLASSIFICATION.

In the sketch which is given under this head, no detailed account of the families and genera of the Madreporaria has been attempted, for this has been rendered superfluous by Professor P. Martin Duncan's recent work, Revision of the Families and Genera of the Sclerodermic Zoantharia or Madreporaria.[1] As, however, considerable light has been thrown on many points of classification by the Challenger Reef-Corals, it was necessary that these points should be stated and considered; and this has been done, generally, in a very brief manner. I believe—and indeed modern investigation forces one to the conclusion—that no satisfactory classification of the Madreporaria is possible until much more is known of the structure of the soft parts of a large number of the genera which have been described from the corallum alone, and until the development of the hard structures, and the relations of the different parts to each other, are much better understood than they are at present.

[1] *Journ. Linn. Soc. Lond.* (Zool.), vol. xviii.

Of a large number of representative genera of Reef-Corals, little or nothing is known of the early stages of the growth either of their simple or of their colonial forms; nor, indeed, does it seem likely that such knowledge will be forthcoming, until some naturalist familiar with the subject has been enabled to collect and study the various types on the reefs.

In the treatment which has been given of the old group of the Rugosa, I have been warned, as indeed I am aware, that I shall probably be subjecting myself to a good deal of criticism; but the conclusions at which I have arrived seem to me unavoidable, when the essential characteristics of the main groups of the recent and fossil corals are compared. Nor would these conclusions be disturbed by the removal of many doubtful genera from the Madreporaria.

The question has been briefly discussed, and was rendered necessary to be discussed by the occurrence of the very remarkable form, *Moseleya latistellata*, the direct and close relationship of which to the most typical of the Cyathophyllidæ is self-evident, while at the same time it is also undeniably Astræid in its characters.

I was inclined at first to place the Cyathophyllidæ, together with *Moseleya*, definitely in the family Astræidæ as a subfamily Moseleyinæ; but it seems more advisable to consider the two families as distinct, *Moseleya* being placed with the Cyathophyllidæ. It is evident, however, that the essential distinctions between the two families are very slight.

Considering the extremely interesting relationships of *Moseleya*, it must be looked upon as one of the most remarkable types of structure brought to light by the Challenger.

ON THE LITERATURE.

It has not been thought necessary to give in this short work a list of the bibliography of the Reef-Corals, for while numerous works exist in which lists are given of the older works on the subject, full information of the more recent works has been given in the recently published and valuable volume by Professor D'Arcy Thompson, A Bibliography of Protozoa, Sponges, Cœlenterata, and Worms.

Constant reference has necessarily been made for the recent forms to the works of Dana, Milne-Edwards and Haime, Verrill, Pourtalès, Agassiz, Duchassaing and Michelotti, Duncan, Semper, Moseley, Lacaze-Duthiers, Lindström, Brüggemann, Studer, Klunzinger, Ridley, Tenison-Woods, &c., not to mention the older writers; and references to writings of the different authors are given in the systematic portion of the work under the genera and species.

GEOGRAPHICAL DISTRIBUTION.

The Reef Madreporaria collected were obtained from the Atlantic and Pacific regions, which in the case of the Reef Madreporaria generally are characterised, with but one doubtful exception, viz., *Isophyllia australis*, by the distinctness of the forms occurring in each.

ATLANTIC REGION.

Thirty-seven species of True Corals, representing fourteen genera, and three species of Hydrocorals, were collected in this region, and were obtained from the following localities :—

1. Bermuda.
2. St. Thomas (Danish West Indies).
3. St. Vincent (Cape Verde Islands).
4. Barra Grande (Brazil).
5. Simon's Bay (Cape of Good Hope).

1. Bermuda.

Since the communication of my note on the Bermuda Reef-Corals,[1] two additional species have come to light, making a total of twenty-three species of True Corals, representing nine genera, and two species of Hydrocorals, which were collected at Bermuda, thus more than doubling the number formerly known.

They comprise the following :—

Oculina coronalis, n. sp.
,, *speciosa*, Edw. and H.
,, *varicosa*, Lesr.
,, *pallens*, Ehrg.
,, *diffusa*, Lamk.
,, *bermudensis*, Duch. and Mich.
Madracis decactis, Lyman (=*Pentalophora decactis*).
Isophyllia strigosa, Duch. and Mich. (=*Isophyllia rigida*, Verrill).
,, *fragilis*, Dana.
,, *dipsacea*, Dana.
,, *australis*, Edw. and H.
,, *cylindrica*, Duch. and Mich.
,, *knoxi*, Duch. and Mich.
,, *marginata*, Duch. and Mich.

[1] Narr. Chall. Exp., vol. i. part. i. p. 145.

Mæandrina strigosa, Dana.
„ *sinuosissima*, Edw. and H.
„ *labyrinthica*, Ell. and Sol.
Diploria cerebriformis, Lamk.
Astræa ananas, Ell. and Sol.
Astræa coarctata, Duch. and Mich.
Siderastræa galaxea, Ell. and Sol.
Agaricia fragilis, Dana.
Porites clavaria, Lamk.
Millepora alcicornis, L.
Millepora ramosa, Pall.

The two species of *Millepora* are very abundant, and contribute largely to the reef formation. While some species, such as the great "Brain-Coral" (*Diploria cerebriformis*), which is conspicuous at the bottom as a bright yellow mass, appear to prefer to grow where the water is lighted up by the sunshine, other species, such as the *Millepora ramosa* and *Isophyllia dipsacea*, seem to thrive best in the shade. One species, *Agaricia fragilis*, which forms very thin and fragile plate-like laminæ, which are, when bleached white, almost the most beautiful of corals, occurs growing in colonies in great abundance in water from a foot to a fathom in depth inside small caverns.[1]

The genera *Astræa* (*Favia*) and *Mæandrina* are for the first time recorded with certainty from this locality; while the species which are new to the fauna comprise:—

Oculina coronalis.
„ *speciosa*.
Isophyllia fragilis.
„ *australis*.
„ *cylindrica*.
„ *knoxi*.
Isophyllia marginata (?).
Mæandrina strigosa.
„ *sinuosissima*.
„ *labyrinthica*.
Astræa ananas.
„ *coarctata*.
Millepora ramosa.

Of these the *Isophyllia fragilis* (= *Mussa fragilis*, Dana), and the *Mæandrina labyrinthica* were recorded by Dana as being found at Bermuda, in his Report on the Zoophytes of the United States Exploring Expedition; but both species have since been omitted from his list of the Bermuda Corals (Cor. and Cor. Islands, p. 114). They are therefore mentioned here as being found for the first time.

With the exception of *Oculina coronalis* (new species) and *Oculina bermudensis*, which at present are only known from Bermuda, the species are all West Indian and are such as one would expect to find. It is, however a noteworthy fact that no representative of the genus *Madrepora* is known to occur at Bermuda, although the three extremely variable species, *Madrepora palmata*, *Madrepora cervicornis* and *Madrepora prolifera*, are perhaps the most abundant, if not the most characteristic of the Reef-Corals of the West Indian Islands. It is possible that the genus does occur on the reefs, though it may be taken for granted, from the absence of representative forms in the collections of the "United States Exploring Expedition" and of the Challenger, that the specimens are

[1] Moseley, Notes by a Naturalist on the Challenger, p. 27.

neither abundant nor of considerable size. As the different species of *Madrepora* are generally characteristic of the warmer tropical waters, it is probable that the explanation of their rarity at, or absence from, Bermuda is to be found in the position of the islands, situated as they are at the extreme thermal limit for reef-building corals.

Besides the species obtained by the Challenger the following forms are also known to occur at Bermuda :—

Oculina valenciennesi, Edw. and H.
Lithophyllia cubensis, Edw. and H.
„ *lavera*, Pall. (=*Lithophyllia urgemone*, Duch. and Mich.).
Isophyllia multilamella, Duch. and Mich. (=*Lithophyllia multilamella*, Duch. and Mich.)
„ *spinosa*, Edw. and H.
Millepora carthaginiensis, Duch. and Mich.

making a total of twenty-eight True Corals and three Hydrocorals which flourish on the reefs.

2. St. Thomas.

Thirteen species of True Corals, representing eight genera, and two species of Hydrocorals, were obtained. They include the following :—

Oculina varicosa, Lesr.
„ *diffusa*, Lamk.
„ *recta*, n. sp.
Pectinia profunda, Dana.
Manicina areolata, L.
Isophyllia aspera, Duch. and Mich.
Agaricia fragilis, Dana.
„ *frondosa*, Duch. and Mich.
Cladocora arbuscula, Lesr.
Madrepora palmata, Lamk.
„ *cervicornis*, Lamk.
„ *prolifera*, Lamk.
Porites astræoides, Lamk.
Millepora alcicornis, L.
„ *carthaginiensis*, Duch. and Mich.

The coral reefs of St. Thomas are remarkable for the large size and luxuriant growth of certain corals upon them, especially two species of the genus *Madrepora*, *Madrepora cervicornis*, and *Madrepora palmata*.[1]

Three species of Corals are recorded for the first time from this locality.

Oculina recta, n. sp.
Agaricia fragilis.
Madrepora cervicornis.

The complete list of the True Corals now known to occur at St. Thomas includes the following seventy-seven species :—

Oculina varicosa, Lesr.
„ *pallens*, Ehrg.
Oculina diffusa, Lamk.
„ *speciosa*, Edw. and H.

[1] Moseley, Notes by a Naturalist on the Challenger, p. 17.

Oculina recta, n. sp.
Madracis mirabilis, Duch. and Mich. (=*Stylophora mirabilis*, Duch. and Mich.).
,, *decactis*, Lyman (=*Stylophora incrustans*, Duch. and Mich. = *Reussia lamellosa*, Duch. and Mich.).
Lithophyllia radians, Duch. and Mich.
,, *cubensis*, Edw. and H.
,, *lacera*, Pall. (= *Lithophyllia argemone*, Duch. and Mich.).
,, *cylindrica*, Duch. and Mich.
,, *dubia*, Duch. and Mich.
Astrangia neglecta, Duch. and Mich.
,, *granulata*, Duch. and Mich.
,, *phyllangioides*, Duch. and Mich.
,, *solitaria*, Lesr.
Phyllangia reptans, Duch. and Mich.
Cladocora arbuscula, Lesr.
Eusmilia fastigiata, Pall. (=*Eusmilia aspera*, Duch. and Mich.).
,, *silene*, Duch. and Mich.
Mussa carduus, Ell. and Sol.
,, *sinuosa*, Lamk.
,, *angulosa*, Pall.
Diploria cerebriformis, Lamk.
Manicina areolata, L.
Mæandrina labyrinthica, Ell. and Sol.
,, *sinuosa*, Lesr.
Leptoria fragilis, Duch. and Mich.
Isophyllia strigosa, Duch, and Mich.
,, *aglæ*, Duch. and Mich.
,, *helianthus*, Duch. and Mich.
,, *conferta*, Duch. and Mich.
Isophyllia dipsacea, Dana.
,, *aspera*, Duch. and Mich.
,, *cylindrica*, Duch. and Mich.
,, *knoxi*, Duch. and Mich.
,, *sinuosa*, Verrill.
,, *marginata*, Duch. and Mich.
,, *verrucosa*, Duch. and Mich.
Mycetophyllia danæ, Edw. and H.
,, *lamarcki*, Edw. and H.
Colpophyllia astræiformis, Duch. and Mich.
,, *gyrosa*, Ell. and Sol.
Dichocœnia pauciflora, Duch. and Mich.
Astræa incerta, Duch. and Mich.
,, *coarctata*, Duch. and Mich.
,, *rotulosa*, Ell. and Sol.
,, *ananas*, Ell. and Sol.
,, *porcata*, Lamk. (?).
Goniastræa varia, Duch. and Mich.
Orbicella abdita, Duch. and Mich.
,, *cavernosa*, Esper.
Cyphastræa micans, Duch. and Mich.
,, *oblita*, Duch. and Mich.
Plesiastræa carpinetti, Duch. and Mich.
Leptastræa caribæa, Duch. and Mich.
Stephanocœnia debilis, Duch. and Mich.
,, *intersepta*, Esper.
,, *michelini*, Edw. and H.
Siderastræa galaxea, Ell. and Sol.
Agaricia purpurea, Lesr.
,, *agaricites*, Pall.
,, *vesparium*, Duch. and Mich.
,, *fragilis*, Dana.
,, *frondosa*, Duch. and Mich.
Madrepora prolifera, Lamk. (=*Madrepora ethica*, Duch. and Mich.).
,, *cervicornis*, Lamk

Madrepora palmata, Lamk. (= *Madrepora flabellum*, Lamk. = *Madrepora alces*, Dana = *Madrepora cornuta*, Duch. and Mich. = *Madrepora thomasiana*, Duch. and Mich.).
Porites astræoides, Lamk.
Porites lævigata, Duch. and Mich.
,, *superficialis*, Duch. and Mich.
,, *subtilis*, Duch. and Mich.
,, *solanderi*, Duch. and Mich.
,, *furcata*, Lamk.
,, *incerta*, Duch. and Mich.
,, *plumieri*, Duch. and Mich.
,, *valida*, Duch. and Mich.

In connection with this list, however, it must be stated that very many of the species have been founded by Duchassaing and Michelotti, who, as pointed out by Pourtalès, have frequently described as new species slight varieties of well known and widely distributed forms. It is probable therefore that many of those enumerated are synonyms of old species, although the information at hand is not sufficient to determine the point with certainty.

3. St. Vincent, Cape Verde Islands.

Three species of true corals which are common to the West Indian reef fauna were collected. They comprise the following :—

Astræa fragum, Esper. | *Porites superficialis*, Duch. and Mich.
Porites guadalupensis, Duch. and Mich.

They form small rounded masses, bright yellow or whitish pink in colour, growing in the numerous rock pools which are exposed at low tide.[1]

4. Off Barra Grande, Brazil.

One species, *Orbicella cavernosa*, Esper, which is common to the West Indian reefs, was obtained at a depth of 30 fathoms. The occurrence of this definite Reef Coral in such a locality and depth is an extremely interesting fact.

5. Simon's Bay, Cape of Good Hope.

Two species were obtained :—*Manicina areolata*, L. ; and *Cladocora arbuscula*, Lesr., at a depth of 10 to 20 fathoms.

The latter species has been recorded already by Professor Moseley in the Report on the Deep-Sea Madreporaria, but it is included here for completeness.

The occurrence of the common West Indian Reef-Coral, *Manicina areolata*, so far south is an extremely interesting fact, to which special reference will be made in the remarks on the thermal limits to distribution.

[1] Moseley, Notes by a Naturalist on the Challenger, p. 47.

PACIFIC REGION.

Two hundred and forty-eight species of True Corals, representing fifty-eight genera, and five species of Hydrocorals, were collected in this region at the following districts:—

1. Tongatabu.
2. Fiji Islands (chiefly at Kandavu and Levuka).
3. Api, New Hebrides.
4. Australia (chiefly at Somerset, Cape York, and Wednesday Island.)
5. Banda.
6. Amboina.
7. Ternate.
8. Mactan Island, Philippines.
9. Samboangan, Philippines.
10. Honolulu.
11. Tahiti.

One species, *Rhodopsammia parallela*, Semper, was also obtained in the Arafura Sea, at a depth of 49 fathoms.

1. Tongatabu.

The following ten species, representing nine genera, were obtained:—

Stylophora prostrata, Klz.
Pocillopora suffruticosa, Verrill.
Cæloria leptoticha, Klz.
Caulastræa distorta, Dana.
Pavonia crassa, Dana.
Pavonia divaricata, Lamk.
Psammocora obtusangula, Lamk.
Turbinaria brassica, Dana.
Madrepora pocillifera, Lamk.
Porites arenosa, Esper.

The genera *Stylophora*, *Pocillopora*, *Cæloria*, *Caulastræa*, and *Turbinaria* are for the first time recorded from this locality, while the following six species are additions to the fauna:—

Stylophora prostrata.
Pocillopora suffruticosa.
Cæloria leptoticha.
Caulastræa distorta.
Pavonia crassa.
Turbinaria brassica.
Porites arenosa.

The following is a list of the Corals which are now known to occur at Tongatabu, comprising twenty-six species:—

Stylophora prostrata, Klz.
Pocillopora suffruticosa, Verrill.
Cæloria leptoticha, Klz.
Leptoria tenuis, Dana.
Caulastræa distorta, Dana.
Astræa danæ, Edw. and H.
Astræa amicorum, Edw. and H.
Acanthastræa spinosa, Edw. and H.
Prionastræa fusco-viridis, Quoy and Gaim.
„ *obtusata*, Edw. and H.
Orbicella solidior, Edw. and H.
Goniastræa quoyi, Edw. and H.
Cycloseris tenuis, Dana.

Pavonia crassa, Dana.
,, *divaricata*, Lamk.
Psammocora obtusangula, Lamk.
Turbinaria brassica, Dana.
Madrepora pocillifera, Lamk.
,, *verrucosa*, Edw. and H.
Madrepora abrotanoides, Lamk. (?).
,, *plantaginea*, Lamk. (?).
Montipora verrucosa, Lamk.
,, *papillosa*, Lamk.
Porites lutea, Edw. and H.
,, *arenosa*, Esper.
Porites levis, Dana.

2. Fiji Islands.

Fifty-nine species of True Corals, representing twenty-nine genera, and one Hydrocoral, were obtained. They were collected at—

(*a*) Kandavu.
(*b*) Levuka.
(*c*) Other Reefs, Fiji.

(a) Kandavu.—Thirty species of True Corals, representing eighteen genera, and one Hydrocoral were collected.

Speaking of the Corals at Kandavu, Professor Moseley writes :—"It is in the shallow sheltered water inside the actual edge of the barrier that the finest and best grown specimens of the Corals are to be found. The tufts, bushes, and rounded masses of the various Corals are to be seen growing here in abundance, but yet scattered over the area, with plenty of more or less barren interspaces in the 'Coral plantation' as Dana terms it. The various forms of the spongy-tissued *Madreporas* are the characteristic feature in the Fijian reefs, there being no less than twenty-six species of *Madrepora* known from Fiji." "I saw however at Fiji no *Madreporas* so large and fine in growth as those of St. Thomas." [1]

The following is a list of the species obtained :—

Stylophora palmata, Blainv.
Seriatopora conferta, n. sp.
Galaxea fascicularis, L.
Mussa fistulosa, Edw. and H.
Cæloria dædalina, Dana.
,, *stricta*, Edw. and H.
,, *esperi*, Edw. and H.
Hydnophora microcona, Lamk.
Goniastræa cerium, Dana.
Astræa versipora, Dana.
Plesiastræa indurata, Verrill.
Plesiastræa urvillei, Edw. and H.
Prionastræa flexuosa, Dana.
,, *obtusata*, Edw. and H.
Acanthastræa irregularis, n. sp.
Lithactinia pileiformis, Dana.
,, *galeriformis*, Dana.
Stephanaria stellata, Verrill.
Dendrophyllia diaphana, Dana.
Madrepora nobilis, Dana.
,, *robusta*, Dana.
,, *seriata*, Ehrg.

[1] Notes by a Naturalist on the Challenger, pp. 306, 307.

Madrepora hebes, Dana.
„ *confraga*, n. sp.
„ *vastula*, n. sp.
Montipora caliculata, Dana.
Montipora foveolata, Dana.
Anacropora solida, n. sp.
Porites arenosa, Esper.
„ *crassistellata*, n. sp.
Millepora gonagra, Edw. and H.

(b) **Levuka.**—Seven species, representing four genera, were obtained from this locality.

Seriatopora hystrix, Dana.
Galaxea explanata, n. sp.
Agaricia regularis, n. sp.
Madrepora pustulosa, Edw. and H.
„ *scabrosa*, n. sp.
„ *rosaria*, Dana.
Madrepora hyacinthus, Dana.

(c) **Other Reefs, Fiji.**—Twenty-eight species, representing thirteen genera, of True Corals were collected at Fiji, on reefs other than those at Kandavu and Levuka. They comprise the following :—

Stylophora palmata, Blainv.
„ *prostrata*, Klz.
Pocillopora brevicornis, Lamk.
Seriatopora caliendrum, Ehrg.
„ *stellata*, n. sp.
Caloria dædalina, Dana.
Hydnophora microcona, Lamk.
Prionastræa quoyi, Edw. and H.
Astræa danæ, Edw. and H.
Fungia confertifolia, Dana.
„ *valida*, Verrill.
Tichoseris obtusata, n. sp.
Turbinaria stellulata, Blainv.
Madrepora cuneata, Dana.
Madrepora robusta, Dana.
„ *echinata*, Dana.
„ *ramiculosa*, Dana.
„ *pocillifera*, Lamk.
„ *laxa*, Lamk.
„ *hebes*, Dana.
„ *conferta*, n. sp.
Montipora scabricula, Dana.
„ *levis*, n. sp.
„ *rubra*, Quoy and Gaim.
„ *palmata*, Dana.
„ *obtusata*, n. sp.
Porites arenosa, Esper.
„ *crassa*, n. sp.

Of the fifty-nine species obtained in the Fiji Islands, fifteen are new, namely :—

Seriatopora conferta.
„ *stellata.*
Galaxea explanata.
Acanthastræa irregularis.
Agaricia regularis.
Tichoseris obtusata.
Madrepora conferta.
Madrepora confraga.
„ *vastula.*
„ *scabrosa.*
Montipora levis.
„ *obtusata.*
Anacropora solida.
Porites crassa.
Porites crassistellata.

Of these one, *Tichoseris obtusata*, is the type of a new genus.

The following twenty-three species of True Corals, together with the preceding fifteen new species, make a total of thirty-six species, which are recorded for the first time from Fiji.

Stylophora prostrata.
Seriatopora caliendrum.
Mussa fistulosa.
Astræa danæ.
„ *versipora.*
Cæloria stricta.
„ *esperi.*
Goniastræa cerium.
Plesiastræa urvillei.
„ *indurata.*
Prionastræa obtusata.
Prionastræa quoyi.
Fungia valida.
Stephanaria stellata.
Dendrophyllia diaphana.
Madrepora nobilis.
„ *pustulosa.*
„ *seriata.*
„ *pocillifera.*
„ *laxa.*
Montipora rubra.
Porites arenosa.

The genera *Agaricia*, *Stephanaria* and *Anacropora*, are for the first time recorded from the Fijian Islands.

The following is a list of the Corals at present known from Fiji, comprising one hundred and ninety-eight species:—

Aerohelia horrescens, Dana.
Stylophora palmata, Blainv.
„ *digitata*, Blainv.
„ *mordax*, Dana.
„ *prostrata*, Klz.
Seriatopora caliendrum, Ehrg.
„ *hystrix*, Dana.
„ *stellata*, n. sp.
„ *pacifica*, Brüg.
„ *conferta*, n. sp.
Pocillopora brevicornis, Lamk.
„ *acuta*, Lamk.
„ *damicornis*, Esper.
„ *danæ*, Verrill.
„ *squarrosa*, Dana.
„ *elegans*, Dana.
„ *grandis*, Dana.
Pocillopora plicata, Dana.
Lithophyllia vitiensis, Brüg.
Mussa fistulosa, Edw. and H.
„ *cactus*, Dana.
„ *multilobata*, Dana.
„ *cerebriformis*, Dana.
Euphyllia rugosa, Dana.
Galaxea explanata, n. sp.
„ *fascicularis*, L.
„ *clavus*, Dana.
„ *hystrix*, Dana.
„ *cespitosa*, Esper.
Tridacophyllia pæonia, Dana.
Caulastræa furcata, Dana.
„ *distorta*, Dana.
Hydnophora microcona, Lamk.
Cæloria dædalea, Ell. and Sol.

Cœloria dædalina, Dana.
„ *stricta*, Edw. and H.
„ *esperi*, Edw. and H.
Leptoria gracilis, Dana.
„ *tenuis*, Dana.
Astræa danæ, Edw. and H.
„ *versipora*, Dana.
„ *pandanus*, Dana.
„ *pallida*, Dana.
Goniastræa favistella, Dana.
„ *cerium*, Dana.
„ *parvistella*, Dana.
Orbicella glaucopsis, Dana.
Prionastræa flexuosa, Dana.
„ *fusco-viridis*, Quoy and Gaim.
„ *virens*, Dana.
„ *sinuosa*, Dana.
„ *farulus*, Dana.
„ *robusta*, Dana.
„ *obtusata*, Edw. and H.
„ *quoyi*, Edw. and H.
Plesiastræa indurata, Verrill.
„ *urvillei*, Edw. and H.
„ *curta*, Dana.
„ *coronata*, Dana.
„ *stelligera*, Dana.
Acanthastræa irregularis, n. sp.
„ *patula*, Dana.
„ *echinata*, Dana.
Cyphastræa danæ, Edw. and H.
Leptastræa pulchra, Dana.
„ *purpurea*, Dana.
Merulina regalis, Dana.
„ *speciosa*, Dana.
„ *rigida*, Dana.
„ *scabricula*, Dana.
Acanthopora horrida, Dana.
Echinopora reflexa, Dana.
Cylicia truncata, Dana.
Fungia valida, Verrill.
„ *lacera*, Verrill.
„ *discus*, Dana.
„ *repanda*, Dana.
„ *dentata*, Dana.
„ *confertifolia*, Dana.
„ *scutaria*, Lamk.
„ *horrida*, Dana.
„ *gigantea*, Dana.
„ *crassa*, Dana.
Herpetolitha limax, Esper.
„ *crassa*, Dana.
Halomitra pileus, Dana (=*Halomitra clypeus*, Verrill).
Zoopilus echinatus, Dana.
Lithactinia galeriformis, Dana.
„ *pileiformis*, Dana.
Pavonia divaricata, Lamk.
„ *frondifera*, Lamk.
„ *cristata*, Ell. and Sol.
„ *decussata*, Dana.
„ *danæ*, Edw. and H.
„ *lata*, Dana.
„ *crassa*, Dana.
Siderastræa clavus, Dana.
Tichoseris obtusata, n. sp.
Agaricia regularis, n. sp.
Phyllastræa tubifex, Dana.
Pachyseris monticulosa, Verrill.
„ *valenciennesi*, Edw. and H.
Psammocora frondosa, Verrill.
„ *fossata*, Dana.
„ *columna*, Dana.
„ *excsa*, Dana.
Stephanaria stellata, Verrill.
Dendrophyllia diaphana, Dana.
„ *danæ*, Verrill.
„ *nigrescens*, Dana.

Turbinaria palifera, Lamk.
„ *peltata*, Esper.
„ *stellulata*, Blainv.
„ *frondens*, Dana.
„ *brassica*, Dana.
Astreopora profunda, Verrill.
„ *pulvinaria*, Lamk.
Madrepora spicifera, Dana.
„ *vastula*, n. sp.
„ *conferta*, n. sp.
„ *hyacinthus*, Dana.
„ *surculosa*, Dana.
„ *prostrata*, Dana.
„ *confraga*, n. sp.
„ *aculeus*, Dana
„ *tubicinaria*, Dana.
„ *valida*, Dana.
„ *retusa*, Dana.
„ *ramiculosa*, Dana.
„ *echinata*, Dana.
„ *cardiuus*, Dana.
„ *rosaria*, Dana.
„ *florida*, Dana.
„ *implicata*, Dana.
„ *tortuosa*, Dana.
„ *aspera*, Dana.
„ *nana*, Studer.
„ *hebes*, Dana.
„ *exigua*, Dana.
„ *cribripora*, Dana.
„ *virgata*, Dana.
„ *horrida*, Dana.
„ *rosacea*, Esper.
„ *arbuscula*, Dana.
„ *formosa*, Dana.
„ *gracilis*, Dana.
„ *pustulosa*, Edw. and H.
„ *robusta*, Dana.
„ *hystrix*, Dana.

Madrepora divaricata, Dana.
„ *scabrosa*, n. sp.
„ *abrotanoides*, Lamk.
„ *humilis*, Dana.
„ *pocillifera*, Lamk.
„ *nobilis*, Dana.
„ *seriata*, Ehrg.
„ *laxa*, Lamk.
„ *cuneata*, Dana.
Montipora levis, n. sp.
„ *obtusata*, n. sp.
„ *rubra*, Quoy and Gaim.
„ *caliculata*, Dana.
„ *verrucosa*, Lamk.
„ *palmata*, Dana.
„ *nodosa*, Dana.
„ *scabricula*, Dana.
„ *incrassata*, Dana.
„ *erosa*, Dana.
„ *danæ*, Edw. and H.
„ *planiuscula*, Dana.
„ *foveolata*, Dana.
„ *digitata*, Dana.
Anacropora solida, n. sp.
Porites arenosa, Esper.
„ *crassa*, n. sp.
„ *crassistellata*, n. sp.
„ *nigrescens*, Dana.
„ *mucronata*, Dana.
„ *levis*, Dana.
„ *palmata*, Dana.
„ *cylindrica*, Dana.
„ *lutea*, Edw. and H.
„ *frugosa*, Dana.
„ *lichen*, Dana.
„ *limosa*, Dana.
„ *reticulosa*, Dana.
„ *favosa*, Dana.
„ *cribripora*, Dana

Alveopora spongiosa, Dana.
Synaræa informis, Dana.
„ *danæ*, Edw. and H.
„ *monticulosa*, Dana.
Goniopora columna, Dana.
Dichoræa boletiformis, Ten.-Woods.
Millepora gonagra, Edw. and H.
„ *tortuosa*, Dana.
„ *platyphylla*, Ehrg.
„ *truncata*, Dana.

3. Api, New Hebrides.

Ten species of True Corals, representing seven genera, were collected at Api namely :—

Pocillopora brevicornis, Lamk.
Goniastræa laxa, n. sp.
Cyphastræa aspera, n. sp.
Pavonia decussata, Dana.
Madrepora millepora, Ehrg.
Madrepora pocillifera, Lamk.
„ *minima*, n. sp.
Porites tenuis, Verrill.
Montipora grandifolia, Dana.
Porites parvistellata, n. sp.

This is the first record of any collection of Reef-Corals from this locality. The conditions under which the forms grow seem to be unfavourable to their full development, and it is probable that the species which are to be found there are but few in number—a marked contrast to their remarkable abundance in the neighbouring Fijian Islands.

With reference to the Corals of Api, Professor Moseley writes "almost everywhere the living Corals are growing only laterally, the upper surfaces being dead from want of sufficient depth of water. In some small specimens of a massive *Porites*, the consequent flattening of the top and expansion of the lateral dimensions was most excellently shown in pieces convenient for museum purposes.

"The Corals, which were few in number of species, were finer grown towards the verge of the reef, as is always the case on shore platforms, the very opposite condition to that which holds in the case of barrier reefs. In some places were deep holes in the coral platform, reminding one of glacier crevasses on a small scale, evidently arising from the loose nature of the sloping beach on which the coral structure here rests.

"A massive *Porites* was one of the Corals on the reef. Some specimens of this species were unattached, though living, being in the form of rounded masses, entirely covered by living polyps, and I suppose from time to time rolled over by the waves." [1]

Of the ten species which were collected, the following four are new :—

Goniastræa laxa.
Cyphastræa aspera.
Madrepora minima.
Porites parvistellata.

[1] Notes by a Naturalist on the Challenger, p. 343.

Four species are characterised as being the most abundant reef-forming species, namely :—

Pocillopora brevicornis.	*Goniastræa laxa.*
Pavonia decussata.	*Madrepora millepora.*

To judge from the specimens which were obtained, the Corals of Api, on the whole, seem to be of extremely small growth.

4. Australia.

Seventeen species of True Corals, representing ten genera, were obtained. They were collected chiefly at Somerset, Cape York, and at Wednesday Island. The exact locality for one species, *Dendrophyllia conferta*, n. sp., is unknown.

(a) Somerset, Cape York.—Eleven species of True Corals, representing seven genera, were obtained, (1) from the shore at low tide, (2) from a depth of 5 fathoms.

"The sandy beach slopes down to end abruptly on a nearly horizontal mud-flat, bare at low water, which is mainly calcareous, and in fact a shore-platform reef, but with few living Corals on it." [1]

Seven species were obtained from the shore at low tide, namely :—

Euphyllia glabrescens, Chamisso.	*Goniastræa quoyi*, Edw. and H.
,, *turgida*, Dana.	*Turbinaria peltata*, Esper.
,, *striata*, Edw. and H.	,, *cinerascens*, Ell. and Sol.

Turbinaria crater, Pall.

Four species were obtained from a depth of 5 fathoms, namely:—

Stylophora digitata, Blainv.	*Mussa aspera*, Edw. and H.
Galaxea musicalis, Esper.	*Alveopora retusa*, Verrill.

(b) Wednesday Island.—Six species of Corals representing four genera, were dredged at a depth of eight fathoms.

Moseleya latistellata, n. sp.	*Turbinaria patula*, Dana.
Dendrophyllia axifuga, Edw. and H.	,, *æqualis*, n. sp.
Turbinaria crater, Pall.	*Montipora exserta*, n. sp.

Of the seventeen species from the Australian region, four are new, namely:—

Dendrophyllia conferta.	*Montipora exserta.*
Turbinaria æqualis.	*Moseleya latistellata.*

The last being the type of a new genus.

[1] Moseley, Notes by a Naturalist on the Challenger, p. 360.

In addition to these the following ten species are recorded for the first time from the Australian region:—

Stylophora digitata.
Galaxea musicalis.
Euphyllia turgida.
„ *striata.*
Mussa aspera.
Goniastræa quoyi.
Turbinaria peltata.
„ *crater.*
„ *patula.*
Alveopora retusa.

This is also the first record of the occurrence of the genera *Galaxea*, *Stylophora* and *Montipora*.

The complete list of the Reef-Corals now known to occur in Australia includes the following sixty-one species:—

Amphihelia venusta, Edw. and H.
Stylophora digitata, Blainv.
Seriatopora subulata, Lamk.
„ *cervina*, Lamk.
Pocillopora acuta, Lamk.
Galaxea musicalis, Esper.
Euphyllia glabrescens, Chamisso.
„ *turgida*, Dana.
„ *striata*, Edw. and H.
„ *rugosa*, Dana.
Antillia constricta, Brüg.
Mussa aspera, Edw. and H.
„ *grandis*, Edw. and H.
„ *solida*, Tenison-Woods.
„ *laciniata*, Tenison-Woods.
Isophyllia (*Homophyllia*) *australis*, Edw. and H.
Symphyllia hemispherica, Tenison-Woods.
Goniastræa quoyi, Edw. and H.
„ *grayi*, Edw. and H.
Astræa bowerbanki, Edw. and H.
Orbicella annuligera, Edw. and H.
Prionastræa australiensis, Edw. and H.
Acanthastræa bowerbanki, Edw. and H.
Plesiastræa urvillei, Edw. and H.
„ *peroni*, Edw. and H.
Cyphastræa microphthalma, Lamk.
„ *muelleri*, Edw. and H.
Merulina ramosa, Edw. and H.
Echinopora rosularia, Lamk.
Cylicia tenella, Dana.
„ *verreauxi*, Edw. and H.
„ *magna*, Tenison-Woods.
„ *quinaria*, Tenison-Woods.
Fungia dentata, Dana.
Cycloseris cyclolites, Lamk.
„ *tenuis*, Dana (= *Cycloseris hexagonalis*), Edw. and H.
„ *sinensis*, Edw. and H (?).
„ *mortoni*, Tenison-Woods.
Pavonia cristata, Ell. and Sol.
„ *frondifera*, Lamk.
Psammoseris cylicioides, Tenison-Woods.
Plesioseris australiæ, Rousseau.
Dendrophyllia aurea, Quoy and Gaim.
„ *axifuga*, Edw. and H.
„ *granosa*, Studer.
„ *conferta*, n. sp.
Endopachys australiæ, Tenison-Woods.

Heteropsammia michelini, Edw. and H.
Balanophyllia elliptica, Tenison-Woods.
„ *buccina*, Tenison-Woods.
Madrepora globiceps, Dana (?).
Turbinaria peltata, Esper.
„ *cinerascens*, Ell. and Sol.
„ *crater*, Pall.
Turbinaria æqualis, n. sp.
„ *patula*, Dana.
Porites gaimardi, Edw. and H.
Rhodaræa calicularis, Lamk.
Montipora exserta, n. sp.
Alveopora retusa, Verrill.
Moseleya latistellata, n. sp.

5. Banda.

Thirty six species of True Corals, representing twenty one-genera, were collected.

"At the base of the Banda volcano, on the shores of the island, a belt of living Corals composed of a considerable variety of species is easily accessible at low tide. Of these Corals the largest bulk is composed of massive Astræids, of which about ten different forms were collected. A massive *Porites* is also very abundant.

"One species of 'Brain-Coral' and an *Astræa* form huge masses, often as much as five feet in diameter, which have their bases attached to the bare basaltic rock of the shore. The tops of all these coral masses are dead and flat and somewhat decayed, but on these dead tops fresh growth is now taking place, showing that slight oscillations in the level of the shore of a foot at least have taken place recently. The tops of the Corals have been certainly killed by being left exposed above water.

"Such slight oscillations are to be expected at the base of an active volcano. The present regrowth is due to the Corals being now again submerged. The fact that these Corals are to be seen growing on the bare rock itself, and not on the débris of older Corals, shows that the coral growth is very recent.

"The Brain-Coral grows in convex, mostly hemispherical masses; the *Astræa* more in the form of vertically standing cylindrical masses, or masses which may be described as made up of a large number of cylinders fused together. The masses of the *Astræa* are usually higher than those of the 'Brain-Coral' by about a foot, because they are able to grow in shallower water, and they thus range also higher up on the beach.

"Many of the masses of this *Astræa* in the shallower water are left dry at each low tide, and appear to suffer no more in consequence than do the common sea-anemones of our English coasts, which are so closely allied to them. I have not seen any other species of Coral thus growing where it is exposed at low tide. The 'Brain-Coral' apparently cannot survive exposure, and hence the tips of its masses have been killed during the change of depth of the water, at about a foot below the height at which those of the *Astræa* have perished.

"The common Mushroom Coral, so often to be seen as a chimney ornament in England (*Fungia* sp.), is most extraordinarily abundant on the shore, at a depth of one or two

feet at low water, and with it an allied larger similarly free growing Coral, *Herpetolitha*. The Mushroom Corals cover the bottom in places in such large quantities, that a cart load of them might be picked up in a very short time; I have nowhere seen them so common."[1]

The species collected include the following:—

Acrohelia horrescens, Dana.
Pocillopora acuta, Lamk.
Seriatopora cervina, Lamk.
Euphyllia glabrescens, Chamisso.
Mussa multilobata, Dana.
Symphyllia acuta, n. sp.
Physogyra aperta, n. sp.
Ulophyllia aspera, n. sp.
„ *cellulosa*, n. sp.
Tridacophyllia manicina, Dana.
Goniastræa quoyi, Edw. and H.
„ *eximia*, Dana.
„ *favistella*, Dana.
„ *coronalis*, n. sp.
Astræa doreyensis, Edw. and H.
„ *speciosa*, Dana.
„ *pandanus*, Dana.
Hydnophora demidoffi, Fischer.
Phymastræa aspera, n. sp.
Merulina crispa, Dana.
Fungia repanda, Dana.
„ *plana*, Studer.
„ *confertifolia*, Dana.
„ *patella*, Ell. and Sol.
Herpetolitha crassa, Dana.
Madrepora securis, Dana.
„ *diffusa*, Verrill.
„ *capillaris*, Klz.
„ *tubigera*, Horn.
„ *mirabilis*, n. sp.
Montipora fragilis, n. sp.
„ *levis*, n. sp.
Anacropora gracilis, n. sp.
Porites gaimardi, Edw. and H.
„ *arenosa*, Esper.
Astreopora profunda, Verrill.

This collection of Reef Corals is the first which has been made in this locality of which there is any published description, and it is perhaps due to this fact that so many of the species are new.

The following ten species are new:—

Symphyllia acuta.
Physogyra aperta.
Ulophyllia aspera.
„ *cellulosa.*
Goniastræa coronalis.
Phymastræa aspera.
Madrepora mirabilis.
Montipora fragilis.
„ *levis.*
Anacropora gracilis

Of these, one, *Physogyra aperta*, is the type of a new genus.

[1] Moseley, Notes by a Naturalist on the Challenger, p. 385.

6. Amboina.

Twenty-five species of True Corals, representing eighteen genera, and one Hydrocoral, were collected.

"The coral banks, though abundant, were not so easily accessible at Amboina as at Banda, being in deeper water, and specimens of most of the species could only be procured by deep wading and diving." [1]

"A striking feature about the Corals of Amboina is the occurrence of several foliated forms in abundance, which form thin and fragile vertical plates." [2]

The species collected consist of the following :—

Stylophora digitata, Blainv.
Pocillopora acuta, Dana.
Euphyllia rugosa, Dana.
Mussa echinata, Edw. and H.
„ *brueggemanni*, n. sp.
Galaxea aspera, n. sp.
„ *fragilis*, n. sp.
Triaucophyllia manicina, Dana.
Goniastræa multilobata, n. sp.
Prionastræa robusta, Dana.
Fungia repanda, Dana.
„ *patella*, Ell. and Sol.
Cryptabacia talpina, Lamk.
Podabacia robusta, n. sp.
Psammocora excesa, Dana.
Oxypora contorta, n. sp.
Madrepora effusa, Dana.
„ *cerealis*, Dana.
„ *gracilis*, Dana.
„ *appressa*, Ehrg.
Turbinaria crater, Pall.
Montipora foliosa, Pall.
„ *patula*, Verrill.
Porites palmata, Dana.
Rhodaræa tenuidens, n. sp.
Millepora intricata, Edw. and H.

Of these, seven species are new, namely :—

Mussa brueggemanni.
Galaxea aspera.
fragilis.
Goniastræa multilobata.
Podabacia robusta.
Oxypora contorta.
Rhodaræa tenuidens.

This collection affords the first reliable information that we have of any large number of Corals found in this locality; for although many specimens were described and figured by Rumphius (Herb. Amboin. VI.), yet, owing to the incompleteness and indefiniteness of the figures and descriptions, it is impossible to state with certainty which species were intended.

The following three species, *Porites saccharata*, Brüg., *Pachyseris speciosa*, Dana, *Astræa amboinensis*, Quoy and Gaimard, also occur at Amboina, making a total of twenty-eight species of True Corals and one Hydrocoral which are now recorded from this locality.

[1] Moseley, Notes by a Naturalist on the Challenger, p. 388. [2] Moseley.

7. Ternate.

Eleven species of True Corals, representing eight genera, and one Hydrocoral, were obtained from the Resident at Ternate. They include the following :—

Amphihelia infundibulifera, Lamk.
Stylophora palmata, Blainv.
Pocillopora paucistellata, n. sp.
„ *squarrosa*, Dana.
Seriatopora aculeata, n. sp.
„ *gracilis*, Dana.
Tridacophyllia manicina, Dana.
Fungia tenuidens, n. sp.
Merulina prolifera, n. sp.
Madrepora secale, Studer.
„ *rosacea*, Esper.
Millepora confertissima, n. sp.

Of these, the following five species are new :—
Pocillopora paucistellata.
Seriatopora aculeata.
Fungia tenuidens.
Merulina prolifera.
Millepora confertissima.

This is the first record of any collection of Reef Corals from this locality.

8. Mactan Island, Cebu.

Nineteen species of True Corals, representing thirteen genera, were obtained.

"Opposite the town of Cebu, the island of Mactan is bordered by a wide belt of denuded coral flat, partly covered at high tide. The surface is scooped out into irregular basins and sharp projecting pinnacles, and covered in all directions with mud, resulting from the denudation. Very few living Corals are to be found on these flats, but the flats are fringed at their seaward margin by small beds of living Corals."[1]

The following comprise the species collected :—

Pocillopora acuta, Lamk.
Seriatopora crassa, n. sp.
Galaxea ellisii, Edw. and H.
Trachyphyllia amarantus, Dana.
Astræa ordinata, Verrill.
„ *fragilis*, Dana.
Cyphastræa pleiades, Ell. and Sol.
„ *microphthalma*, Lamk.
„ *brueggemanni*, n. sp.
Goniastræa grayi, Edw. and H.
Fungia repanda, Dana.
Halomitra tiara, Verrill.
Madrepora austera, Dana.
„ *aspera*, Dana.
Montipora rigida, Verrill.
„ *erosa*, Dana.
Porites lutea, Edw. and H.
„ *mirabilis*, n. sp.
Goniopora pedunculata, Quoy and Gaim.

[1] Moseley, MS. Diary.

Of these three species are new :—

Seriatopora crassa. | *Cyphastræa brueggemanni.*
Porites mirabilis.

Montipora rigida is the most abundant reef-forming species.

9. Samboangan.

Forty-two species of True Corals, representing sixteen genera, and two Hydrocorals, were collected.

"The beach of the island was almost entirely composed of Coral débris. The main part of the mass was made up of the lighter, more friable perforated Corals. The considerable abundance of *Millepora* and great quantity of *Tubipora* was remarkable and characteristic. There are no extensive series of reefs about Samboangan, merely fringing reefs of small extent. In the full wash of the tide in the channel the shore is sandy and muddy and apparently without Corals." [1]

The species collected comprise the following :—

Stylophora flabellata, n. sp.
,, *cellulosa*, n. sp.
Pocillopora damicornis, Esper.
,, *danæ*, Verrill.
Seriatopora caliendrum, Ehrg.
,, *valida*, Ehrg.
,, *contorta*, Studer.
,, *ocellata*, Ehrg.
,, *compressa*, Studer.
,, *cervina*, Lamk.
Galaxea tenella, Brüg.
,, *clavus*, Dana.
Symphyllia sinuosa, Quoy and Gaim.
Hydnophora tenella, n. sp.
Fungia paumotensis, Stutchb.
Cycloseris tenuis, Dana.
,, *cyclolites*, Lamk.
,, *distorta*, Michelin.
,, *sinensis*, Edw. and H.
Cycloseris discus, n. sp.
,, *freycineti*, Edw. and H.
Rhodopsammia parallela, Semper.
Psammocora ramosa, n. sp.
Dendrophyllia equiserialis, Edw. and H.
Madrepora angulata, n. sp.
,, *canalis*, n. sp.
,, *manni*, n. sp.
,, *securis*, Dana.
,, *rosacea*, Esper.
,, *tenuis*, Dana.
,, *aculeus*, Dana.
,, *parilis*, n. sp.
,, *prostrata*, Dana.
Montipora effusa, Dana.
,, *exesa*, Verrill.
,, *irregularis*, n. sp.
,, *lima*, Lamk.
Porites palmata, Dana.

[1] Moseley, MS. Diary.

Porites explanata, n. sp.
Rhodaræa calicularis, Lamk.
„ *tenuidens*, n. sp.
Tichopora tenella, n. sp.
Millepora murrayi, n. sp.
„ *gonagra*, Edw. and H.

Of these the following fourteen are new species :—

Stylophora flabellata.
„ *cellulosa.*
Psammocora ramosa.
Hydnophora tenella.
Cycloseris discus.
Madrepora angulata.
„ *canalis.*
Madrepora manni.
„ *parilis.*
Montipora irregularis.
Porites explanata.
Rhodaræa tenuidens.
Tichopora tenella.
Millepora murrayi.

One of these, *Tichopora tenella*, is the type of a new genus.

This is the first published record which gives an account of the Reef-Corals of Samboangan. Many other species than those included have been recorded from the Sulu Sea and from the Philippines generally, which doubtless will be found to flourish at or about Samboangan.

The Reef-Corals now known from the Philippines and Sulu Sea include the following ninety-four species :—

Stylophora digitata, Blainv.
„ *flabellata*, n. sp.
„ *cellulosa*, n. sp.
Pocillopora acuta, Lamk.
„ *damicornis*, Esper.
„ *danæ*, Verrill.
„ *verrucosa*, Ell. and Sol.
Seriatopora caliendrum, Ehrg.
„ *valida*, Ehrg.
„ *contorta*, Studer.
„ *ocellata*, Ehrg.
„ *compressa*, Studer.
„ *cervina*, Lamk.
„ *octoptera*, Ehrg.
„ *gracilis*, Dana.
„ *crassa*, n. sp.
Ulangia stokesana, Edw. and H.
Cladocora conferta, Dana.
Galaxea tenella, Brüg.
Galaxea ellisii, Edw. and H.
„ *clavus*, Dana.
„ *fascicularis*, L.
„ *hexagonalis*, Edw. and H.
Lithophyllia lacrymalis, Edw. and H.
Trachyphyllia amarantus, Dana.
Symphyllia sinuosa, Quoy and Gaim.
Hydnophora tenella, n. sp.
Astræa ordinata, Verrill.
„ *fragilis*, Dana.
Cyphastræa pleiades, Ell. and Sol.
„ *microphthalma*, Lamk.
„ *brueggemanni*, n. sp.
Goniastræa grayi, Edw. and H.
Merulina crispa, Dana.
„ *laxa*, Dana.
Echinopora undulata, Dana.
Fungia patella, Ell. and Sol.
„ *dentata*, Dana.

Fungia danæ, Edw. and H.
,, *repanda*, Dana.
,, *paumotensis*, Stutchb.
Halomitra tiara, Verrill.
Cryptabacia tulpina, Lamk.
Cycloseris tenuis, Dana (= *Cycloseris hexagonalis*, Edw. and H).
,, *cyclolites*, Lamk.
,, *distorta*, Michelin.
,, *sinensis*, Edw. and H.
,, *discus*, n. sp.
,, *fregineti*, Edw. and H.
Pavonia danæ, Edw. and H.
Leptoseris papyracea, Dana.
Trochoseris stokesi, Edw. and H.
Heloseris crispa, Ehrg.
Psammocora ramosa, n. sp.
Rhodopsammia parallela, Semper.
Heteropsammia michelini, Edw. and H.
,, *multilobata*, Moseley.
Dendrophyllia equiseriatis, Edw. and H.
Madrepora labrosa, Dana.
,, *securis*, Dana.
,, *prostrata*, Dana.
,, *austera*, Dana.
,, *canalis*, n. sp.
,, *aspera*, Dana.
,, *manni*, n. sp.
Madrepora angulata, n. sp.
,, *aculeus*, Dana.
,, *rosacea*, Esper.
,, *tenuis*, Dana.
,, *parilis*, n. sp.
,, *echidnæa*, Lamk.
,, *cerealis*, Dana.
,, *formosa*, Dana.
,, *gracilis*, Dana.
,, *arbuscula*, Dana.
,, *brachiata*, Dana.
,, *echinata*, Dana.
Montipora effusa, Dana.
,, *rigida*, Verrill.
,, *excesa*, Verrill.
,, *irregularis*, n. sp.
,, *crosa*, Dana.
,, *lima*, Lamk.
Porites palmata, Dana.
,, *mirabilis*, n. sp.
,, *explanata*, n. sp.
,, *lutea*, Edw. and H.
Rhodaræa calicularis, Lamk.
,, *tenuidens*, n. sp.
Tichopora tenella, n. sp.
Goniopora pedunculata, Quoy and Gaim.
Synaræa erosa, Dana.
Millepora murrayi, n. sp.
Millepora gonagra, Edw. and H.

10. Honolulu.

Twelve species of True Corals, representing four genera, were collected. They comprise the following:—

Pocillopora cespitosa, Dana.
,, *ligulata*, Dana.
,, *nobilis*, Verrill.
,, *verrucosa*, Ell. and Sol.
,, *plicata*, Dana.
Stephanaria stellata, Verrill.
Montipora capitata, Dana.
,, *verrucosa*, Lamk.
Porites lichen, Dana.
,, *compressa*, Dana.
,, *bulbosa*, n. sp.
,, *tenuis*, Verrill.

Of these one species, *Porites bulbosa*, is a new one, while five other species are recorded for the first time, namely :—

Pocillopora verrucosa.
Stephanaria stellata.
Montipora verrucosa.
Porites lichen.
Porites tenuis.

The complete list of the Reef-Corals now known from the Sandwich Islands includes the following thirty species :—

Pocillopora cespitosa, Dana.
„ *ligulata*, Dana.
„ *nobilis*, Verrill.
„ *aspera*, Verrill.
„ *plicata*, Dana.
„ *verrucosa*, Ell. and Sol.
„ *mæandrina*, Dana.
„ *informis*, Dana.
„ *frondosa*, Verrill.
Astræa hombroni, Rousseau (?).
„ *rudis*, Verrill (?).
Cœlastræa tenuis, Verrill (?).
Leptastræa stellulata, Verrill.
Cyphastræa ocellina, Dana.
Fungia paumotensis, Stutchb.
„ *verrilliana*, Quelch = *Fungia* (*Lobactis*) *danæ*, Verrill = *Fungia dentigera*, Dana, non *Fungia dentigera*, Leuck.
Pavonia varians, Verrill.
Stephanaria stellata, Verrill.
Dendrophyllia manni, Verrill.
Montipora capitata, Dana.
„ *verrucosa*, Lamk.
„ *patula*, Verrill.
Porites lichen, Dana.
„ *compressa*, Dana.
„ *bulbosa*, n. sp.
„ *tenuis*, Verrill.
„ *mordax*, Dana.
„ *lobata*, Dana.
Alveopora verrilliana, Dana.
Synaræa irregularis, Verrill.

It is a noteworthy peculiarity of the Coral fauna of the Sandwich Islands that no representative of the widely distributed genus *Madrepora* is found on the reefs.

11. Tahiti.

Forty species of True Corals, representing fourteen genera, and two Hydrocorals, were collected. They comprise the following :—

Pocillopora grandis, Dana.
„ *solida*, n. sp.
„ *cespitosa*, Dana.
Leptastræa ehrenbergana, Edw. and H.
„ *roissyana*, Edw. and H.
Leptastræa transversa, Klz.
„ *solida*, Edw. and H.
Fungia horrida, Dana.
„ *rugosa*, n. sp.
„ *acutidens*, Studer.

Fungia scutaria, Lamk.
„ *paumotensis*, Stutchb.
„ *concinna*, Verrill.
„ *discus*, Dana.
Sandalolitha dentata, n. sp.
Pavonia formosa, Dana.
„ *prætorta*, Dana.
Pachyseris speciosa, Dana.
Domoseris porosa, n. sp.
„ *solida*, n. sp.
„ *regularis*, n. sp.
Trochoseris stokesi, Edw. and H.
Cylloseris incrustans, n. sp.
Madrepora retusa, Dana.
„ *plantaginea*, Lamk.
„ *virgata*, Dana.
Madrepora danæ, Verrill.
„ *nasuta*, Dana.
„ *pavilligera*, Dana.
„ *speciosa*, n. sp.
„ *cytherea*, Dana.
„ *surculosa*, Dana.
„ *laxa*, Lamk.
„ *parilis*, n. sp.
Montipora aspera, Verrill.
„ *papillosa*, Lamk.
Porites arenosa, Esper.
„ *latistellata*, n. sp.
Synaræa convexa, Verrill.
Napopora irregularis, n. sp.
Millepora nodosa, Esper.
„ *gonagra*, Edw. and H.

"The most abundant reef-forming species on the reefs about Papiete are the species of *Pavonia*. With them are associated in quantity the species of *Porites*, the *Madrepora*, and the *Montipora*. The *Astræa* (*Leptastræa*) occurs in very small masses, and contributes no appreciable part of the reef mass. The *Fungias* are so abundant, lying scattered everywhere on the surface of the reef in a few inches of water only, that their share here in the reef-formation must be no inconsiderable one. The closely-set vertical plates of the *Pavonia* are better adapted than any other for catching and holding the various débris of which the bulk of every coral-reef is composed. The *Pocilloporas* are abundant, but are not here, as at Hawai, the leading and principal form."[1]

The following eleven species are new :—

Pocillopora solida.
Fungia rugosa.
Sandalolitha dentata.
Domoseris porosa.
„ *solida.*
Domoseris regularis.
Cylloseris incrustans.
Madrepora speciosa.
„ *parilis.*
Porites latistellata.
Napopora irregularis.

Of these, four species, *Sandalolitha dentata*, *Domoseris porosa*, *Cylloseris incrustans*, and *Napopora irregularis*, are types of new genera.

The following nineteen species are recorded for the first time from Tahiti :—

[1] Moseley, MS. Diary.

Pocillopora cespitosa.
Leptastræa roissyana.
„ *ehrenbergana.*
„ *transversa.*
„ *solida.*
Fungia horrida.
„ *acutidens.*
„ *concinna.*
Pachyseris speciosa.
Trochoseris stokesi.
Madrepora retusa.
„ *plantaginea.*
„ *virgata.*
„ *laxa.*
Montipora aspera.
„ *papillosa.*
Porites arenosa.
Millepora nodosa.
Millepora gonagra.

The list of the Reef-Corals now known to occur in the Society Islands, includes the following fifty-five species :—

Pocillopora cespitosa, Dana.
„ *suffruticosa*, Verrill.
„ *grandis*, Dana.
„ *squarrosa*, Dana.
„ *solida*, n. sp.
Mussa costata, Dana.
„ *cytherea*, Dana.
Plesiastræa coronata; Dana.
Leptastræa roissyana, Edw. and H.
„ *ehrenbergana*, Edw. and H.
„ *transversa*, Klz.
„ *solida*, Edw. and H.
Fungia horrida, Dana.
„ *discus*, Dana.
„ *acutidens*, Studer.
„ *concinna*, Verrill.
„ *scutaria*, Lamk.
„ *paumotensis*, Stutchb.
„ *tenuifolia*, Dana.
„ *rugosa*, n. sp.
Sandalolitha dentata, n. sp.
Herpetolitha stricta, Dana.
Pavonia formosa, Dana.
„ *prætorta*, Dana.
Phyllastræa explanata, Verrill.
Domoseris porosa, n. sp.
„ *solida*, n. sp.
„ *regularis*, n. sp.
Cylloseris incrustans, n. sp.
Trochoseris stokesi, Edw. and H.
Dendrophyllia radiata, Verrill.
Madrepora retusa, Dana.
„ *danæ*, Verrill.
„ *plantaginea*, Lamk.
„ *virgata*, Dana.
„ *nasuta*, Dana.
„ *paxilligera*, Dana.
„ *speciosa*, n. sp.
„ *cytherea*, Dana.
„ *surculosa*, Dana.
„ *turbinata*, Dana.
„ *globiceps*, Dana.
„ *cuspidata*, Dana.
„ *hebes*, Dana (?).
„ *tubicinaria*, Dana (?).
„ *laxa*, Lamk.
„ *parilis*, n. sp.
Montipora lichen, Dana.
„ *effusa*, Dana.
„ *aspera*, Verrill.

Montipora papillosa, Lamk.
Synaræa convexa, Verrill.
,, *solida*, Verrill.
Porites arenosa, Esper.
Porites latistellata, n. sp.
Napopora irregularis, n. sp.
Millepora nodosa, Esper.
,, *gonagra*, Edw. and H.
Millepora incrassata, Dana.

GENERAL RESULTS OF DISTRIBUTION.

Tabular view of the number of Genera and Species obtained, with their Localities.

ATLANTIC.

Locality.	Number of Species obtained.	Number of Genera represented.	Number of New Species.	Number of New Genera.
St. Thomas, West Indies,	15	9	1	...
Bermuda,	25	10	1	...
St. Vincent, Cape Verde,	3	2	...	...
Barra Grande, Brazil,	1	1	...	...
Simon's Bay, Cape of Good Hope,	1	1	...	...

PACIFIC.

Tongatabu,	10	9	...	...
Fiji Islands,	60	30	15	1
Api, New Hebrides,	10	7	4	...
Australia,	17	10	4	1
Banda,	36	21	10	1
Amboina,	26	19	7	...
Arafura Sea,	1	1	...	...
Ternate,	12	9	5	...
Mactan Islands,	19	13	3	...
Samboangan,	44	17	14	1
Honolulu,	12	4	1	...
Tahiti,	42	15	11	4

Thus from the above table it will be seen that extremely interesting results were obtained from nearly all the Stations at which Corals were collected; while from the standpoint of the variety and rarity of the forms included, special mention must be made of the Tahiti and Banda collections. The most remarkable form, however, which was collected, *Moseleya latistellata*, was dredged off Wednesday Island, Australia.

DISTRIBUTIONAL AREAS.

A sharp line of demarcation apparently separates the Reef-Coral fauna of the Atlantic on the one hand and the Pacific and Indian Oceans on the other (with the doubtful exception of *Isophyllia australis*, which has been recorded from both regions by Milne-Edwards and Haime, Cor., ii. p. 375); though from the occurrence of *Manicina areolata* in 20 fathoms water in Simon's Bay, Cape of Good Hope, it may be doubted whether the two areas will prove to be so sharply defined.

In the Atlantic, no definite districts can be made out, the fauna throughout being essentially West Indian.

In the Pacific and Indian Oceans, the fauna is characterised generally by more or less uniformity, exception being made, however, in the cases of the districts of the Sandwich Islands and the West Coast of America, each of which appears to be more or less markedly circumscribed by the distinctness of the forms which flourish there.

The Reef-Corals of Tahiti are similar in many respects to the Corals of the Red Sea, many species being common to both; while almost the same may be said of the Corals of the Friendly Islands, the Fiji Islands, and the Philippines.

It must be confessed, however, that any attempt to generalise from the facts at hand, as to the relation of the fauna of the chief centres of coral growth in the Pacific and Indian Oceans, must be at least premature, and this owing to several causes.

In the first place, for a large number of the species which have been described, more especially by the old authors, no definite locality is recorded; the locality being either altogether omitted or given under such vague terms as, "Indian Ocean," "East Indies," "Austral Seas," "Australasia," &c.

In the second place, of the large collection of Corals in different museums but little is really known, owing to the want of published detailed reports or catalogues of the collections.

And in the third place, while several voyages and expeditions have been accomplished through many parts of the coral regions during which collections have been made with more or less interesting results, yet no prolonged and exhaustive examination of the genera and species of Reef-Corals found in any one locality, excepting in the Red Sea, has yet been made by any practised naturalist; so that our knowledge of the distribution of the Reef-Corals throughout the multitudinous islands and formations of the Indian and Pacific Oceans is, at the best, fragmentary and unreliable.

It is a welcome sign, however, of the impetus which recent research has given to the study of the Anthozoa, that two practised naturalists are carrying on investigations into the fauna of certain districts of the Indian and Indo-Pacific Oceans and it cannot be doubted that extremely interesting additions will be made therefrom to our knowledge of the Corals of these regions.

BATHYMETRICAL LIMITS TO DISTRIBUTION.

It has usually been considered that the growth of Reef-Corals is limited to depths of from 1 to 30 fathoms. This conclusion has been much shaken in recent years, and the light thrown upon the question by species obtained by the Challenger, tends to show that the depth limits will have to be extended.

Five species were obtained from depths ranging to more than 30 fathoms.

Trochoseris stokesi,	30 to 70 fathoms.
Domoseris regularis,	30 to 70 fathoms.
Porites lichen,	1 to 40 fathoms.
Montipora rapitata,	1 to 40 fathoms.
Pocillopora nobilis,	10 to 40 fathoms.

And while it may be doubted whether the two former species play any considerable part in reef-formation, it must be acknowledged that the three latter are definite reef-builders. It seems tolerably certain, however, that the zone of most active growth is confined to comparatively shallow waters, at depths of 1 to 20 fathoms.

THERMAL LIMITS TO DISTRIBUTION.

An interesting fact in relation to this question has been brought to light by the Challenger—namely, that a specimen of an undoubted reef-building species, *Manicina areolata*, was obtained in Simon's Bay, Cape of Good Hope, between lat. 34° and 35° S., at a depth of 10 to 20 fathoms, the temperature at that depth being 65° (Challenger observations). The thermal limit of 68°, which has usually been considered the lowest temperature limit to regulate the distribution of reef-building forms, may still be held to be the extreme limit for reef-formation, which results from the luxuriant growth of the reef-building species. It is evident, however, that these species, independently of reef-formation, may have a wider range. In this relation special reference must be made to the fact of the occurrence of a species of *Madrepora*, *Madrepora borealis*, Edw. and H. (Milne-Edwards and Haime, Cor., iii. p. 144), in the cold waters of the White Sea, near Archangel, the type specimen of which, collected by Mons. Eugéne Robert in 1829, I have seen in the Paris Museum, and which has since been examined again for me by Mons. Poirier of the Paris Museum; a fact which is the more remarkable in that the species of *Madrepora*, with this exception, are characteristic of the warmest waters of the reef regions. It seems to me that considering the thermal conditions under which these two species, *Manicina areolata* and *Madrepora borealis*, are known to have developed, we are on the threshold of the knowledge as to the distribution in place of those forms which, in the warmer tropical waters, are confined to within comparatively narrow limits as reef-builders.

The occurrence of such a characteristic West Indian Reef-Coral as *Manicina areolata*

within a few miles of the southernmost extremity of the African mainland is the more remarkable when the distinctness of the Atlantic and the Indian and Pacific reef fauna is borne in mind. It seems probable that when our knowledge of the distribution of the reef species is more extended, it will be found that many species are common to these apparently distinct regions; the path of communication being that indicated by the *Manicina areolata*, round the southern extremity of Africa. The thermal barrier can scarcely be considered a difficulty in the way, since the eastern and western shores of the mainland at this point are bathed by the warm waters of the Mozambique and South Atlantic currents respectively. In this connection it is extremely desirable to have a thorough and accurate examination of the species of Corals on the coasts of Natal.

Milne-Edwards and Haime (Cor., ii. p. 137) have recorded the Pacific and Indian Ocean species *Stylophora palmata* from the Cape of Good Hope, but it may be doubted whether this term was not used in its more general sense, The Cape, that is, signifying Cape Colony. If the species be found actually at the Cape of Good Hope, we have at least one species which is known to be common to the Atlantic and the Indian and Pacific reef regions.

PECULIAR CASES OF DISTRIBUTION.

Under this head, brief reference is made to some of the more peculiar conditions under which certain species of Corals are known to exist, one case of which the Challenger furnishes.

1. Generally speaking the presence of fresh or brackish water is sufficient to prevent all coral growth; *Cylicia rubeola*, Quoy and Gaimard, however, flourishes in the River Thames, New Zealand, and *Madrepora cribripora*, Dana, inhabits nearly fresh water.

2. Muddy water is equally destructive to coral growth, yet *Porites limosa*, Dana, flourishes under such conditions, while *Astræa bowerbanki*, Edw. and H., as recorded by the Rev. J. E. Tenison-Woods, does not seem to mind mud or sediment, or even muddy brackish water; it grows incrusting a large proportion of the stones at the mouth of the Mangrove Creek, Australia, all these stones being covered with mud and slime, and washed over, twice in the twenty-four hours, by muddy, brackish water.

3. The extreme saltness and density of the waters of the Dead Sea might have been thought sufficiently unfavourable for the development of coral life, but *Stylophora pistillata*, Esper, a common Red Sea species, is recorded from this locality by Milne-Edwards and Haime.

4. Exposure at low tide is generally destructive to coral life, but at Banda, as observed by Professor Moseley, an Astræan which was thus exposed appeared to suffer no more in consequence than do the common sea-anemones of our own coasts (see quotation under "Banda Corals"), while Dana records that species of *Porites* and *Siderastræa* left exposed at low tide, do not appear to suffer from the effects of sunshine and rain while thus exposed.

CLASSIFICATION.

The classification here proposed for the Sclerodermic Zoantharia or Madreporaria is, in the main, based on the system of Milne-Edwards and Haime, as developed in the Histoire Naturelle des Coralliaires. This system, owing to the researches of numerous investigators within the last few years, has been considerably altered, and the changes necessitated have been very recently (August 1884) given expression to by Professor P. Martin Duncan in his valuable and much needed Revision of the Families and Genera of the Sclerodermic Zoantharia, from which revision unfortunately the Madreporaria Rugosa were excluded.

While acknowledging my extreme indebtedness to this work, among others, of Professor Duncan, I must at the same time state that the examination of the Reef-Corals of the Challenger, and their comparison with recent and fossil forms, have thrown much new light upon classification, and have led to the modification of his scheme in many not unimportant particulars, chief among which may be mentioned the treatment of the section Madreporaria Rugosa, which here has been merged into that of the Madreporaria Aporosa.

The more immediate cause which has led to this change has been the structure and relationship of the remarkable Coral *Moseleya latistellata*, which was dredged by the Challenger in 8 fathoms water off Wednesday Island, Torres Straits, Australia, and for which a new subfamily, Moseleyinæ, of the Astræidæ, was provisionally proposed,[1] while its close affinity with the Rugosa and the probable dismemberment of that group were at the same time indicated. This form has now been definitely placed under the family Cyathophyllidæ.

The opinion of Louis Agassiz that the Rugosa should be referred to the Hydrozoa rather than to the Anthozoa, has not been justified; while, on the other hand, the tendency of more recent investigation and thought has been to show that, although many of the forms generally referred to the Rugosa are probably not Madreporarian, yet the essential characteristics of the more typical forms are decidedly those of the Zoantharia Sclerodermata. This opinion on the classification of the Rugosa has been most recently endorsed by Professor Duncan, who groups them under the Zoantharia Sclerodermata or

[1] *Ann. and Mag. Nat. Hist.*, 1884, vol. xiii. p. 293.

Madreporaria, while he cautiously states that "probably most of its genera are not Madreporarian."[1]

In the following classification the Madreporaria are primarily divided into three sections.

Section I. Madreporaria Aporosa (=Madreporaria Aporosa and Madreporaria Rugosa, Auctt).
" II. Madreporaria Fungida.
" III. Madreporaria Perforata.

Section I. MADREPORARIA APOROSA.

The definition of this section, as limited by Professor Duncan,[2] needs but one slight alteration in the characters of the septa to make it applicable to the section, as extended above, to include the old Madreporaria Rugosa. The septa may be distinctly lamellate, and solid or cribriform, or indistinctly lamellate, becoming more or less vesicular.

Professor Duncan also observes that "the hexameral arrangement of the septa is not constant; it may be pentameral, heptameral, octameral, or decameral."[3] To this should have been added that it may also be tetrameral.[4]

The group Madreporaria Aporosa, as now extended, is defined as follows:—

Madreporaria with simple or colonial forms. Hard structures usually solid and imperforate. Theca or wall solid, may be epithecate. Arrangement of the septa variable. Septa distinctly lamellate, and solid or cribriform, or indistinctly lamellate, becoming more or less vesiculate. Interseptal loculi open throughout, or closed more or less by endotheca in the form of dissepiments, tabulæ, and stereoplasm. Calicles of different shapes.

This section is divided into three subsections, each of which is again divided into families.

Subsection I. Turbinolida.
" II. Oculinida.
" III. Astræida.

Subsection I. TURBINOLIDA.

This subsection is not treated of in the present Report, but is characterised as follows:—Corallum simple or in colonies without exotheca. Septal loculi open to the base.

[1] *Journ. Linn. Soc.* (Zool.), vol. xviii. p. 6.
[2] Revision, p. 7.
[3] Revision, p. 7.
[4] Vide *Holocystis*, Revision, p. 130.

Family I. TURBINOLIDÆ.

Genera *Desmophyllum, Flabellum,* &c.

Family II. CYATHAXONIDÆ.

Genera *Cyathaxonia, Guynia, Duncania, Haplophyllia.*[1]

Family III. DASMIDÆ.

Genus *Dasmia.*

Subsection II. OCULINIDA.

This subsection is characterised as follows :—

Colonial Madreporaria Aporosa in which the interseptal loculi are usually open to the base, but sometimes with dissepiments or tabulæ. Internal space diminishing on account of the growth of stereoplasm. Solid intercalicular cœnenchyma usually well developed.

Family I. OCULINIDÆ.
,, II. POCILLOPORIDÆ.

These families are taken as defined by Professor Duncan,[2] but it seems to me very doubtful whether they will prove to be really distinct.

Subsection III. ASTRÆIDA.

This section is characterised as simple or colonial Madreporaria Aporosa, in which the interseptal loculi contain dissepimental endothecæ, or are more or less replaced by vesiculate endothecæ, with or without tabulæ, and in which solid intermural cœnenchyma is rarely developed.

Family I. ASTRÆIDÆ.
,, II. CYATHOPHYLLIDÆ.
,, III. STAURIDÆ.
,, IV. CYSTIPHYLLIDÆ.

These families are accepted much according to their ordinary definition, the differences from which, in each case, will be briefly denoted.

The Cystiphyllidæ form a fairly natural and distinct family, as is acknowledged, I believe, by all authorities. Its very decided relationship to the Cyathophyllidæ, on the

[1] For Remarks on the Fossula, see Subsection III., Astræida.

[2] Revision, pp. 36, 46.

one hand, however, is clearly marked, since in many genera of the latter the condition of the septa, especially at their extreme peripheral portion, is closely similar to that which is normal throughout the whole internal structure of the Cystiphyllidæ; while on the other hand doubtful representatives of the family present distinctly Alcyonarian features in their opercular characters.

The Stauridæ, among which is included the genus *Holocystis*, which has been placed by Professor Duncan in the Astræidæ, in their typical form differ from the more typical of the Astræidæ, as here limited, simply in the distinctly tetrameral arrangement of their septa. Very little value can be given to the absence of a columella or of costæ in *Stauria*, for not only are these structures well developed in the genus *Holocystis*, but they are among the characters of Astræida some of the most variable in development. A variability in the distinctness of the tetrameral arrangement of the septa, even in the Stauridæ, however, is clearly indicated in *Metriophyllum*, where, instead of the distinct and strong Maltese cross characteristic of *Stauria*, are found the four bundles of septa which present a transitional character between this family and the Cyathophyllidæ, a transitional character originally pointed out by Milne-Edwards and Haime (Cor., iii. p. 328).

It is difficult to draw any clear line of demarcation between the families Astræidæ and Cyathophyllidæ, the more especially that certain genera of the one are clearly related to genera of the other possessing nearly identical characteristics. The usually accepted grouping of the two families seems to be based more essentially on their distribution in time than on any constant structural characteristics of real classificatory value. With a view more perfectly to grasp the essential characteristics tending on the one hand to relate and on the other to separate them, it will be instructive to examine, if only briefly, the main features which are supposed so to distinguish the forms commonly known as the Rugosa as to entitle them to the rank of a distinct order or suborder.

While confessedly, in its most essential respects, the corallum of a typical Rugose Coral is quite identical with that of a typical Aporose Madreporian, it has been contended that the following more striking points of difference in the Rugose Coral are sufficient to give it ordinal or subordinal rank.

1. The septa appear to be primitively developed in four systems instead of six.
2. The septa are rendered more or less irregular in their arrangement by the presence of a curious vacant space (sometimes three or four), which is known as the fossula, and which appears to take the place of one of the primitive four septa.
3. When the septa are well developed, they generally present themselves in the adult as of two sizes only, a larger and a smaller.
4. Tabulæ are usually present, in conjunction with the septa.

5. The compound coralla possess no true cœnenchyma, and one of their commonest modes of increase is by means of calicular gemmation.

As regards the first point, it must be remembered that modern investigation gives a constantly declining value to any essential difference between a tetrameral and hexameral arrangement of the septa. In many Astræids, not only is it an impossibility in the adult forms to prove the predominance of six septa, but also to derive the number present from such a type; for the total number present of those that are well developed is often not a multiple of six. And while in such a form as *Stauria* we are confronted with a distinctly marked cruciate arrangement, it is necessary to bear in mind that the transitional forms between the Stauridæ and the Cyathophyllidæ shew a decided decrease in the distinctness of such an arrangement, until in many species of typical Cyathophyllidæ, as in species of *Cyathophyllum*, *Lithostrotion*, *Acervularia*, &c., we arrive at a condition in which the septa are simply radially arranged without any indication whatever of a tetrameral type.

As regards the second point, the presence or absence of a fossula is essentially a matter of but slight importance, and at most is recognised to be but of generic value, the genera which possess and those which do not possess a fossula being grouped together in the same tribe or subfamily, while to take a more especial case, as in the genus *Cyathophyllum*, in which a small septal fossula is often present, species which possess and those which do not possess this fossula are grouped under the same genus, the character in this case being recognised as not even possessing generic value.

As regards the third point, it must be claimed that the presence of but two sizes of septa is as characteristic of a large number of the most typical Astræids (species of *Orbicella*, *Prionastræa*, &c.), as it is of the Rugose Coral. On the other hand, in the most typical of the Rugosa, in which the tetrameral arrangement is most visible, as for instance in *Stauria*, the septa are markedly of very different sizes according to the cycle to which they belong; a condition seen most clearly in a transverse section of the corallum, not only in *Stauria* but in many species of the Cyathophyllidæ, where by the union of the smaller septa with the larger, a clear idea of their inequality can be gained by the extremely variable position of their point of coalescence and its distance from the centre of the calicle. In *Strombodes* (as in *Strombodes murchisoni*) the extremely variable size of the septa is a most marked character; in species of *Endophyllum* the variability among themselves of the smaller and larger septa is distinctly seen; while in many species of *Cyathophyllum* (*Cyathophyllum stutchburyi*, *Cyathophyllum regium*, *Cyathophyllum rugosum*, *Cyathophyllum marmini*, &c.) where roughly it may be stated that the septa are alternately equal, a transverse section shows that there is a variability in the exact length not only of the shorter septa, but also of the larger which approach the centre, for while certain of them do actually reach there, many as certainly stop short of it. It seems to me that if transverse sections of typical Astræids be taken for comparison,

very little value can be given to the character that the septa of the Rugosa are generally of two sizes.

As regards the fourth point, it must be conceded that tabulæ are more characteristic of the Rugosa as a whole than they are of the Astræids, though exceptions occur on both sides; for while there are Rugosa which are destitute of tabulæ, there are also Astræids which possess them. It is moreover a very doubtful point as to what value should be placed on the presence or absence of these structures, considering the high degree of development to which they attain in other and widely distinct Aporose Madreporaria.

As regards the fifth and last point, it must be stated that the absence of a true cœnenchyma in the compound coralla, and the increase by calicular gemmation are as sharply characteristic of some of the most highly developed of the Astræids (as for instance, the forms of the genus *Prionastræa*) as of the Rugosa.

Thus, as the result of the foregoing considerations, there is not a single characteristic of the old group Rugosa which will essentially separate its forms from the more typical Astræids; and a direct expression is given to this fact by placing the families of the old Rugosa (except the family Cyathaxonidæ, which has been placed under the subsection Turbinolida) with the family Astræidæ, under the subsection Astræida.

An extremely interesting comparison of a typical recent Astræid with a Cyathophyllid may be made by selecting specimens of *Prionastræa favosa* (=*Madrepora favosa*, Ell. and Sol.) and the compound form of *Cyathophyllum helianthoides*, Goldf. In the former the calicles are large, being about 30 mm. in diameter, and deep, about 10 to 15 mm; the walls are simple, and excessively thin above, and in transverse section are seen to be very slightly developed and vesiculate; the septa are numerous, often about 48, and subequal, projecting nearly evenly to the centre, where their innermost teeth give rise to a false columella; and the dissepiments are very abundant, oblique and vesiculate. In *Cyathophyllum helianthoides* the foregoing characters are almost identical, but the dissepiments are placed higher, leaving but a small extent of septa free exteriorly, and at the centre give place or give rise to slightly developed tabulæ.

This comparison, indeed, brings to light not only the essential relation between the two types, and the close affinities of the families to which they belong, but points to the most constant difference which will serve to distinguish the Astræidæ and the Cyathophyllidæ, while the generally prevailing hexameral arrangement of the septa in the former will serve still further to limit them—characters in both cases, it must be confessed, of doubtful value.

The relation of the form *Moseleya latistellata* to the Astræidæ, as exemplified in *Prionastræa favosa*, Ell. and Sol., is equally striking and suggestive. In *Moseleya latistellata* the calicles are as large as or larger than those of *Prionastræa favosa*; the septa are much more numerous, markedly of unequal sizes, often continuous from calicle to calicle, and give no indication of hexameral arrangement, while in a simple young form,

which has budded from the surface of a large and partially dead basal calicle, from which also the chief mass of the colony has developed, a tetrameral arrangement is distinctly visible owing to a cruciate arrangement of four larger septa; the wall is simple, extremely thin, and very slightly and irregularly developed; the innermost terminations of the septa exteriorly give rise to a false columella, the larger septa lower down meeting quite at a point; the dissepiments are extremely abundant and vesiculate, coming high up so as to leave but a very small part of the septa free exteriorly, except at the centre, where a distinctly marked depression is visible; these dissepiments, in transverse section, are seen to be more or less distinctly arranged in concentric circles, especially towards the centre where, in the single specimen of the species which was obtained, two distinct nearly solid, sub-infundibuliform tabulæ are present, which seem to take their origin from the concentration and coalescence of the dissepiments, and in which the course of the larger septa is clearly visible.

From the consideration of this form, *Moseleya latistellata*, and its comparison on the one hand with a typical Astræid like *Prionastræa favosa*, and on the other hand with a Cyathophyllid like the compound form of *Cyathophyllum helianthoides*, or like *Cyathophyllum regium*, it results that the essential difference from the Astraid, and the essential similarity to the Cyathophyllid, is to be found in the abundant development of vesiculate endotheca coming high up in the calicle so as to leave a very small portion of the septa free exteriorly, except at the centre of the fossa, the dissepiments towards the centre being arranged in more or less concentric circles, giving rise to or replaced by tabulæ in which the course of the septa is traceable: characters which are, with but slight modifications, the distinguishing features of forms of the family Cyathophyllidæ.

Section II. MADREPORARIA FUNGIDA.

This section is taken as defined by Professor Duncan,[1] by whom it is divided into the following five families.

Family I. PLESIOFUNGIDÆ.
„ II. LOPHOSERIDÆ.
„ III. FUNGIDÆ.
„ IV. ANABACIADÆ.
„ V. PLESIOPORITIDÆ.

Of these the first three are represented in the collection.

[1] Revision, p. 132.

Family I. Plesiofungidæ.

The family Plesiofungidæ has been founded by Professor Duncan to include many forms which modern investigation has shown to be more or less transitional between the Aporosa and the Fungida. As characterised by the presence of endothecal dissepiments as well as of synapticulæ, it includes many of the genera which have been referred to the Lophoseridæ, as for instance, *Tichoseris* (in the preliminary notice of which no dissepiments were described), *Pavonia* (=*Lophoseris*, Edw. and H.) in the thick and more massive species of which true dissepiments are well developed and were described by Verrill,[1] and *Agaricia*. In many genera which are closely related to the foregoing, and in which generally the species are thin and explanate, no dissepiments have been described; but observations are wanting on many of the forms.

Family II. Cycloseridæ.

The family Cycloseridæ [=Lophoseridæ (pars), Duncan] includes those Fungida in which the wall is solid, and neither perforated nor echinulate, and in which there are no dissepiments. The family name is taken from the most typical genus of the group, *Cycloseris*, and is thus directly comparable to the family name Fungidæ, which has been derived from the typical genus *Fungia*. As the genera *Pavonia* (=*Lophoseris*, Edw. and H.) and *Agaricia* now take their place among the Plesiofungidæ, the terms Pavonidæ, Lophoseridæ, and Agaricidæ are not available for this family.

Family III. Fungidæ.

It is interesting to observe that though in the adult forms of the most typical genus of this family the wall is perforated, yet in the young stages it is frequently almost solid and imperforate.

Section III. MADREPORARIA PERFORATA.

This section is taken as defined by Professor Duncan.[2] It includes three families, all of which are represented in the collection.

Family I. Eupsammidæ.
„ II. Madreporidæ.
„ III. Poritidæ.

Following Mr. S. O. Ridley,[3] I have placed the genera *Montipora* and *Anacropora* in the family Madreporidæ. It must be acknowledged, however, that the families Poritidæ and Madreporidæ are separated by but slight characters.

[1] *Trans. Connect. Acad.*, vol. i. p. 542. [2] Revision, p. 172. [3] *Ann. and Mag. Nat. Hist.*, ser. 5, vol. xiii. p. 278.

TABULAR VIEW OF THE FAMILIES AND GENERA REPRESENTED IN THE COLLECTION.

MADREPORARIA.

Section I. MADREPORARIA APOROSA.

Subsection I. OCULINIDA.

Family Oculinidæ.

Genus 1. *Oculina.*
„ 2. *Acrohelia.*
„ 3. *Amphihelia.*
Genus 4. *Madracis.*
„ 5. *Stylophora.*

Family Pocilloporidæ.

Genus 1. *Seriatopora.*
Genus 2. *Pocillopora.*

Subsection II. ASTRÆIDA.

Family Astræidæ.

Genus 1. *Cladocora.*
„ 2. *Galaxea.*
„ 3. *Caulastræa.*
„ 4. *Euphyllia.*
„ 5. *Physogyra.*
„ 6. *Pectinia.*
„ 7. *Trachyphyllia.*
„ 8. *Mussa.*
„ 9. *Symphyllia.*
„ 10. *Isophyllia.*
„ 11. *Ulophyllia.*
„ 12. *Tridacophyllia.*
„ 13. *Diploria.*
„ 14. *Manicina.*
Genus 15. *Mæandrina.*
„ 16. *Colporia.*
„ 17. *Hydnophora.*
„ 18. *Astræa.*
„ 19. *Goniastræa.*
„ 20. *Acanthastræa.*
„ 21. *Primastræa.*
„ 22. *Plesiastræa.*
„ 23. *Phymastræa.*
„ 24. *Orbicella.*
„ 25. *Cyphastræa.*
„ 26. *Leptastræa.*
„ 27. *Merulina.*

Family Cyathophyllidæ.

Genus *Moseleya.*

Section II. MADREPORARIA FUNGIDA.

Family Plesiofungidæ.

Genus 1. *Siderastræa.*
„ 2. *Tichoseris.*
Genus 3. *Pavonia.*
„ 4. *Agaricia.*

Family Cycloseridæ.

Genus 1. *Cycloseris.*
„ 2. *Trochoseris.*
„ 3. *Pachyseris.*
„ 4. *Cylloseris.*
Genus 5. *Domoseris.*
„ 6. *Psammocora.*
„ 7. *Stephanaria.*
„ 8. *Oxypora.*

Family Fungidæ.

Genus 1. *Fungia.*
„ 2. *Halomitra.*
„ 3. *Podabacia.*
„ 4. *Cryptabacia.*
Genus 5. *Lithactinia.*
„ 6. *Herpetolitha.*
„ 7. *Sanalolitha.*

Section III. MADREPORARIA PERFORATA.

Family Eupsammidæ.

Genus 1. *Rhodopsammia.*
Genus 2. *Dendrophyllia.*

Family Madreporidæ.

Genus 1. *Madrepora.*
„ 2. *Turbinaria.*
„ 3. *Astreopora.*
Genus 4. *Anacropora.*
„ 5. *Montipora.*

Family Poritidæ.

Genus 1. *Porites.*
„ 2. *Napopora.*
„ 3. *Synaræa.*
„ 4. *Goniopora.*
Genus 5. *Rhodaræa.*
„ 6. *Tichopora.*
„ 7. *Alveopora.*

HYDROCORALLINÆ.

Family Milleporidæ.

Genus *Millepora.*

DESCRIPTIONS OF GENERA AND SPECIES.

Section MADREPORARIA APOROSA.

Subsection OCULINIDA.

Family Oculinidæ.

Genus 1. *Oculina*, Lamarck.

Oculina, (pars), Lamarck, Hist. Anim. sans Vert., ii. p. 283, 1816.
„ Milne-Edwards and Haime, Cor. (Hist. Nat.), ii. p. 105.
„ Duncan, Revision (Madreporaria), p. 41.

Seven species of this genus are represented.

1. *Oculina diffusa*, Lamarck.

Oculina diffusa, Lamarck, Hist. Anim. sans Vert., ii. p. 285, 1816.
„ „ Milne-Edwards and Haime, Cor., ii. p. 107.

A very fine large specimen and many small much branched pieces were obtained. The small pieces, which were from Bermuda, have the surface scarcely granulated, while the branches are very shortly divided and much thickened; the branchlets are subequal in thickness throughout, and closely crowded with calicles at their extremities, owing to the clustered incipient branchlets.

The large specimen from St. Thomas presents some interesting features, differing considerably from the Bermuda specimens; but on comparison with a large series of the species, it is impossible to separate it by any fairly constant character. This specimen consists of a closely crowded and densely branched tuft, very coalescent below, with numerous, nearly straight, upright branchlets above, which are often 3 cm. long. The extremities are not clustered with incipient branchlets nor crowded with closely placed calicles. New branchlets, with rare exceptions, originate, not at the extreme apex of the branches, but laterally from numerous buds on different parts of the corallum, chiefly on the basal parts of the smaller branchlets. The calicles on the apical parts are 3 to 4 mm. in diameter, regularly oval, rather distant and prominent, with well-marked

rather deep interspaces; and the calicular margin is thickened and neatly rounded. The surface is very strongly granulated.

Localities.—St. Thomas, shallow water; Bermuda.

2. *Oculina pallens*, Ehrenberg.

Oculina pallens, Ehrenberg, Cor. roth. Meer., p. 79.
„ „ Dana, Zoophytes, p. 395.

As pointed out by Pourtalès, the species is distinct from *Oculina diffusa*, of which Milne-Edwards and Haime had supposed it a synonym; it is, however, closely allied to that species. The specimen obtained consists of a loosely ramose corallum about 30 cm. high, with long spreading branches somewhat attenuated at the extremity, and sparsely coalescent. Ehrenberg gives the width of the calicles as $1\frac{1}{2}$ lines and Dana as $1\frac{1}{4}$, but this would seem to vary very much at different parts of the corallum. On the thick branches the calicles are circular and about 3 to 3·5 mm. wide, while on the branchlets and apical parts they become oblique and are longer and narrower, the long diameter being often as much as 4 mm. The septa are very uneven and exsert; the primaries and secondaries very strong and wide and project far towards the centre of the calicle, the pali being scarcely distinct paliform teeth which are often very small, especially in the apical oblique calicles where the septa become more exsert, and like the costæ curve towards the distal part of the branches. In these apical calicles, the septa towards the distal parts are very markedly longer and inclined.

The drawings of the calicles on pl. iii. fig. 17, in the Report on the Florida Reefs[1] are fairly good, but figs. 14 and 15 are misleading, owing to the indistinctness of the essential structure of the calicles. In these drawings the septa should be prolonged almost to the centre, with very small and thin pali; while in the oval calicle the distal septa should be enlarged, elongated and curved.

The deeper, less prominent calicles which are oblique at the distal parts, the very exsert and large septa, and the slightly developed pali apparently separate this species from the *Oculina varicosa*, to which it is, however, very closely allied.

Locality.—Bermuda.

3. *Oculina varicosa*, Lesueur.

Oculina varicosa, Lesueur, Mém. du Mus., vi. p. 291, pl. xvii. fig. 19.
„ „ Dana, Zoophytes, p. 394.

Four specimens of this species were obtained, three of which are very large, with extremely elongated branchlets, sometimes more than 30 cm. long. The calicles are 3 to 4

[1] Agassiz, *Mem. Mus. Comp. Zoöl.*, Cambridge, U.S.A., vol. vii. No. 1.

mm. wide, not deep, often shallow, close in the same spiral line, and generally very prominent, especially at the basal parts of the branches, where they are about 4 to 8 mm. above the general surface. They are circular, with the sides nearly at right angles to the general surface, but towards the proximal parts the bases of the calicles are swollen in such a manner as to form a concavity from the edge of the calicle to the general surface of the corallum. The calicular fossa is moderately deep in the very prominent calicles, but shallow in the others. The costæ are very distinct, long and curved; the septa are exsert, rather thick and subequal, the primaries being a little thicker and longer than the secondaries or tertiaries; the pali are well-developed but rather thin, and arranged as in *Oculina speciosa*, often nearly filling up the calicular fossa, the secondaries being larger than the primaries and forming an outer circle; columella generally well developed.

As pointed out by Verrill and Pourtalès, this species is distinct from *Oculina diffusa*, of which Milne-Edwards and Haime had supposed it a synonym. It is also quite different from *Oculina petiveri*, which Pourtalès had supposed to be its synonym. From the following additional characters of the *Oculina petiveri*, it will be seen how distinct it is from the present species: the costæ are scarcely marked and short; the bases of the calicles are much swollen, but broad rather than high, so that a distinct convexity is formed from the edge of the calicle to the general surface; the septa are very thin, not exsert, and project but very slightly at their upper portion towards the centre of the calicle; the pali are extremely thin and are simply the inner prolongations of the septa, being not at all distinct from these nor from the columella.

The *Oculina varicosa* is very close to the *Oculina virginea*, Lamarck, from the Indian Ocean (?), the specimen of which from the collection of Lamarck is in the Paris Museum; and, indeed, it may be oubted whether they are specifically distinct. The only character that apparently separates them is the degree of prominence of the calicles, especially of those on the basal parts of the branches. In the *Oculina varicosa* the prominence increases from the distal to the proximal part of the axis, becoming very great at the base, while in *Oculina virginea* they are usually less prominent at the basal parts than at the middle of the branches, being about 2 mm. above the general surface.

Very good figures of the species are given in the Report on the Florida Reefs, in which pl. ii. shows the characteristic form, while pl. i. represents the variety with scarcely prominent calicles: magnified views of the calicles showing their essential structure are given in pl. ii. fig. 4 and pl. iii. figs. 8, 9.

Localities.—Bermuda; St. Thomas.

4. *Oculina coronalis*, n. sp. (Pl. I. figs. 6 6c).

Corallum arborescent, large, very much branched, 10 to 14 mm. thick below, becoming very attenuated above; branches and branchlets about 2 to 10 cm. long, often

divaricate and contorted, close or spreading in all directions, seldom coalescent. Calicles deep, raised about 0·75 to 1·5 mm., rarely depressed, generally somewhat swollen at the base, uniformly circular except at the very extremity of the branchlets where they become slightly oval, placed irregularly at unequal distances apart, not infrequently in vertical lines, small especially on the branchlets, about 2 to 3 mm. in diameter. Costæ scarcely distinct except near the calicles, curved. Septa in three cycles, a little exsert, very granulated, thickened outside, their inner free edge vertical and scarcely projecting from the wall, and joining the pali low down in the cup, being separated from them by a very deep notch; the primaries thicker and more projecting than the secondaries, and these slightly more so than the tertiaries. Pali twelve, a little unequal, well developed, more so than in *Oculina speciosa*, wide and very thick, closely arranged in a circle and very distinctly bunch-like and apparently isolated in the cavity of the calicle, the secondaries being often more elevated than the primaries, but never so as to give a shallow appearance to the fossa. Columella well developed and consisting of rounded and thick papillæ.

The very numerous, long, crowded branches and branchlets spreading in all directions; the deep, rather prominent, small, circular calicles; the faint costæ; the narrow vertical septa; and the specially developed bunch-like group of pali forming a marked crown, will distinguish this from all other species. It is near the *Oculina speciosa*, but differs markedly in the characters of its calicles.

Locality.—Bermuda.

5. *Oculina speciosa*, Milne-Edwards and Haime.

Oculina speciosa, Milne-Edwards and Haime, Cor., ii. p. 106.

This specimen consists of a ramose corallum with few, long branches, remotely coalescent. Towards the apical parts of the branches the calicles are less raised than in the type, being scarcely 1 mm. above the general surface. On the thick branches they may be as prominent, or be scarcely raised; while in many places, as occurs also in the type specimen of Milne-Edwards and Haime, they are sunk in shallow, circular depressions about 8 to 9 mm. in diameter, so that curved ridges are formed between adjoining calicles. The costæ are distinct close to the calicles, but are only faintly marked at the base where they curve downwards, and are not at all marked on the ridges. The septa are rather broad and join the pali directly at the upper part of the shallow cup. In most of the calicles the pali are found as described by Milne-Edwards and Haime, but in not a few the primaries are very small, and often one or two are undeveloped, a condition that brings this species into very close relation with *Oculina valenciennesi*. The calicles seem to be always regularly circular and erect, though both in this and in the type specimen the extremities of the branches, where usually oval calicles are found in other species, are broken off.

The species is very close to the *Oculina varicosa*, Lesueur, but is distinguishable by the smaller, shallower and less prominent calicles which are not swollen at the base.

Locality.—Bermuda.

6. *Oculina recta*, n. sp. (Pl. I. figs. 5 5*b*).

Corallum much branched, with the branches elongated and irregularly ascending, often coalescent, about 10 to 15 mm. in diameter at the basal stock, and diminishing gradually in size to about 5 mm. at the apex, but often subequal throughout a large extent. Calicles very evenly prominent, being about 1·5 to 2 mm. above the general surface, with their sides regularly perpendicular to the branches, circular, rather deep but sometimes shallow especially towards the basal parts, about 2 to 3 mm. in diameter, rather crowded in spiral lines, about 3 to 5 mm. apart; the cups are often sunk in a slight depression in which the costæ are generally visible, though not continued on the slight intercalicinal ridges. Septa unequal, exsert, granulated, very thin and knife-like, broad, scarcely separated from the pali except by a very shallow notch. Pali twelve, small, thin and broad, continuous with and slightly thicker than the septa owing to the rougher granulations on their sides. Columella papilliform, generally fused in a solid mass with the inner edges of the pali. Surface very finely granulated.

This species is close to the *Oculina speciosa*, but is distinguishable by the rather deep and prominent calicles with perpendicular sides; by the thinner septa, and by the thin pali which are scarcely separated from the septa and are sunk down in the calicular fossa. It is represented by two specimens.

Locality.—St. Thomas, West Indies.

7. *Oculina bermudensis*, Duchassaing and Michelotti.

Oculina bermudiana, Duchassaing and Michelotti, Suppl. Mém. Cor. des Antilles, p. 68, pl. ix. figs. 1, 2.

The specimen of this species consists of a large, branching, dense corallum, rising apparently from many points of attachment, and becoming very coalescent. Its highest branches rise to about 34 cm. and the chief basal partsare nearly 3·5 cm. thick, while in the type specimen, which was of small growth, the greatest thickness was nearly 2 cm. A marked peculiarity of the species, not mentioned in its definition, is the nearly uniform thickness of many of the main branches, which thus become very obtuse at the apex, and show but little tendency to produce branchlets, which when produced are nearly as thick and blunt as the main branches, from which they originate. In a few branches, however, this condition is not marked and they become gradually smaller, and even attenuate, the incipient branchlets at different points of the corallum being

very irregular, and varying from 8 mm. to 25 mm. in thickness. The branches and branchlets are terminated by an apical calicle. The calicles are irregularly placed, uniformly circular, varying from 3 to 5 mm. in width, but the average size is 4 mm. They are somewhat shallow, slightly prominent at the apical parts, but with a distinctly raised margin, becoming very sunken on the thick branches of the base, so as to render the general surface very uneven, owing to the prominent intermediate ridges thus formed. These ridges are marked by a central depressed line which forms the outer limit of the costæ, which are very unequal, distinct, and curved. There are usually twenty-four septa, but they vary from twenty to twenty-six in a few calicles, slightly exsert, and granulated; pali twelve, very granulated, thin, and becoming confluent in their inner parts with the well-developed columella.

This very interesting species, of which one specimen has hitherto been found, resembles *Oculina banksi* (*Oculina mammillaris*) in many of its characters, but is quite distinct from it.

Locality.—Bermuda.

Genus 2. *Acrohelia*, Milne-Edwards and Haime.

Acrohelia, Milne-Edwards and Haime, Cor., ii. p. 115.
„ Duncan, Rev. Madrep., p. 40.

A single species of this genus is represented.

Acrohelia horrescens (Dana).

Oculina horrescens, Dana, Zoophytes, p. 392, pl. xxviii. fig. 1.
Acrohelia horrescens, Milne-Edwards and Haime, Cor., ii. p. 116.

Two specimens of this species were obtained. They form many branched clumps about 12 cm. high, and but small portions were living when taken. A noticeable feature of the corallum is its somewhat vesicular structure, being much less dense than in other Oculinidæ, and this is apparent even on its outer surface, where it is especially marked in the angles of the branches and at the upper junctions of the calicles on the basal parts of the corallum.

Locality.—Banda, taken from the shore at low water.

Genus 3. *Amphihelia*, Milne-Edwards and Haime.

Amphihelia, Milne-Edwards and Haime, Cor., ii. p. 118.
„ Duncan, Rev. Madrep., p. 39.

A single species of this genus is represented.

Amphihelia infundibulifera (Lamarck).

Oculina infundibulifera, Lamarck, Hist. Anim. sans. Vert., p. 457, 1836.
Amphihelia infundibulifera, Kent, Proc. Zool. Soc. Lond., 1871, p. 276, pl. xxiv.

A very fine and large specimen of this rare species was obtained. It is more than 22 cm. in height, with numerous irregular subflabellate branches, being about 17 cm. at its widest part. A very good description of this species, accompanied by a figure, is given by Saville Kent.

Locality.—Ternate.

Genus 4. *Madracis*, Milne-Edwards and Haime.

Madracis, Milne-Edwards and Haime, Cor., ii. p. 139.
„ Duncan, Rev. Madrep., p. 45.

The single species of this genus, which is represented, was described by Duchassaing and Michelotti under a new genus *Reussia*, for which, as the name was previously employed, Saville Kent proposed the name *Pentalophora*. Following Verrill and Pourtalès, I have sunk *Pentalophora* in the present genus, since they are separated by but slight characters.

Madracis decactis (Lyman).

Astræa decactis, Lyman, Proc. Boston Soc. Nat. Hist., vi. p. 260.
Reussia lamellosa, Duchassaing and Michelotti, Mém. Cor. des Antilles, p. 63, pl. ix. figs. 7 and 8.

The form of this species is very variable. Pourtalès records that it is generally thin and incrusting, but also at times rises into club-like masses, and even takes the form of thick branches bluntly expanded at the end. The specimen described and figured by Duchassaing and Michelotti as *Reussia lamellosa* is lobate and bluntly ramose; while the specimen obtained by the Challenger on the reefs at Bermuda is a moderately thick and long branch somewhat narrowed and compressed at the summit, obtuse and furcate, and largely incrusted with foreign matter at the base. It is about 5 cm. long and 1·5 cm. thick. The calicles are somewhat deeper and the septa less exsert than in the ordinary massive specimen, but with the exception of its longer and narrower form, it differs in no constant character from the typical specimens of the species.

The plate ix. fig. 7 of Duchassaing and Michelotti apparently gives the magnified view of the corallum, and not fig. 9, as stated in the text.

Locality.—Bermuda.

Genus 5. *Stylophora*, Schweigger.

Stylophora, Schweigger, Beobacht. Naturf., 1819.
„ Milne-Edwards and Haime, Cor., ii. p. 133.
„ Duncan, Rev. Madrep., p. 45.

Of this genus five species are represented. In one of these, *Stylophora cellulosa*, a curious modification of the typical styliform columella is found; for while in the calicles

on the apical parts of the branches and branchlets a small style is visible at the junction of the septa, no indication of it is present in the other calicles of the corallum, where the columella takes the form of a thick central concave mass with which the septa are united.

1. *Stylophora digitata* (Pallas).

Madrepora digitata, Pallas, Elench. Zooph., p. 326.
Porillopora andreossyi, Savigny, Egypte, Polyp., pl. iv. fig. 3.
Stylophora digitata, Milne-Edwards and Haime, Cor., ii. p. 135.

Two specimens were collected which, though presenting interesting varietal differences, can be separated from this species by no constant characters. In the one, which is large and thick, many of the branches are divaricate or subdivaricate, very swollen and obtusely rounded at the apex; the calicles are quite large and rather far apart, and the labial projections small, more especially at the apical parts. In the other, which is of much smaller growth, the branches are much subdivided and ascending, becoming quite small and subacute above, and the calicles are rather smaller and closer and less prominent at the upper margin.

A very good description, with figures, is given by Klunzinger in his work on the Red Sea Corals.

Localities.—The larger specimen from Somerset, Cape York, 5 fathoms; the smaller from Amboina.

2. *Stylophora flabellata*, n. sp. (Pl. I. figs. 1–1*b*).

Corallum flabellate; the branches subequal, rapidly dichotomising at a rounded angle and always regularly in the same plane, very unevenly bent, compressed so as to present an elliptic outline in transverse section, which is uniformly about 8 to 10 mm. in diameter in the long axis, though somewhat less at the base; branchlets slightly smaller than the branches, quite short, subterete, very obtusely rounded. Calicles circular or subcircular, rather deep and large, 1 to 1·5 mm. in diameter, very elongately spinulous at the margin, not touching but often separated from each other by wide interspaces, nearly even with the surface, and not prominent at the upper margin. Septa six, extremely narrow above, where they are seen as slightly thickened prominent spinules at the margin of the calicle, distinct only at the basal part of the fossa, where they thicken and unite at the centre to form a thick central columella which is produced upwards as a small style, and which is generally slightly elongated in the direction of the long axis of the branch. The interseptal chambers are usually very deep, especially those which are situated at the distal part of each calicle; they are generally narrow, but

become wider on the apical portions of the corallum. Secondary septa absent, probably represented by the small elongated spinules situated between those corresponding to the primary septa at the margin of the calicles.

The styliform prolongation of the columella small, short and pointed, sometimes slightly broadened, and generally more conspicuous in the apical calicles. Cœnenchyma very dense at the surface, but light and cellular within; surface very distinctly and finely echinulate.

This species resembles somewhat the *Stylophora pistillata*, but it may easily be distinguished from it. The smaller distant calicles which are even with the surface, not prominent above, and which never attain the great depth of those of *Stylophora pistillata*, will serve to mark it. The nature of the septa, which are never broad as in *Stylophora pistillata*, and the interseptal chambers, the columella, and the general habit of the corallum furnish additional characters.

A single rather large specimen was obtained, in which the flabellate mode of growth is very clearly marked.

Locality.—Samboangan, Philippines.

3. *Stylophora prostrata*, Klunzinger.

Stylophora prostrata, Klunzinger, Cor. roth. Meer., ii. p. 62, pl. vii. fig. 8; pl. viii. fig. 7.

A very fine specimen and a fragment were obtained, which seem referable to this species, though differing considerably in habit. The stems are much branched and divaricate, and diminish gradually in size, so that the branchlets are small and slender. The corallum tends to spread horizontally, and the branches and branchlets are somewhat flattened in that plane.

Localities.—Tongatabu, 18 fathoms; reefs, Fiji.

4. *Stylophora palmata* (Blainville).

Siderastræa palmata, Blainville, Dict. des Sci. Nat., vol. lx. p. 350.
Stylophora palmata, Milne-Edwards and Haime, Cor., ii. p. 137.
" " Klunzinger, Cor. roth. Meer., ii. p. 63, pl. vii. fig. 6, and pl. viii. fig. 11.

Specimens in the collection differ in no respect from the Red Sea forms. The branches are of very variable size and form, being either thick and broad and more or less curved, or thick and almost rounded and somewhat swollen at the top. The apical parts are often infested by parasites which make a lodgment in the corallum.

The *Stylophora mordax* (Dana) has been referred with doubt to this species, both by Milne-Edwards and Haime and by Klunzinger; the species certainly does not seem distinct.

Localities.—Ternate; Kandavu and other reefs, Fiji.

5. *Stylophora cellulosa*, n. sp. (Pl. I. figs. 2–2*c*).

Corallum forming, large more or less rounded clumps, the branches of which are elongated, much compressed or angular, and divided throughout into rather broad subpalmate lobes; these branches are from 1·5 to 4 cm. wide and about 7 to 10 mm. thick at their upper part, being often subterete at their base; the lobe-like branchlets are short, broad, rounded or angular, often swollen at their apex, and subdivide rapidly and longitudinally into smaller lobes, apparent as incipient lateral crests, in a plane at right angles to their width. Calicles very crowded towards the apical parts, where they are from 1 to 1·5 mm. in diameter, polygonal and deep, with generally thin, but unequal interspaces, which are of an open cellular structure; towards the basal parts they are circular, smaller and shallower, less crowded but not distant, and separated by dense interspaces; throughout the corallum the calicles are even with the surface and generally fringed by small spinules, those on the distal margin being often rather more elongated than those on the proximal, but the upper edge is neither prominent, arched nor vaulted. Septa six, well developed, those in the extreme distal calicles being very conspicuous, broad and very thin, meeting quite at the centre, the interseptal chambers being very wide and deep; those in the proximal calicles being much less conspicuous, distinct only at the bottom of the fossa, much thickened and not exsert, coalescing with the columella so as to form a thick central mass which is concave above, and which, nearly filling up the bottom of the cup, renders the interseptal chambers small and narrow, though quite deep. The styliform prolongation of the columella generally absent, except in the extreme apical calicles, where it is represented by a very small, short pointed style placed above the point of union of the thin septa. Cœnenchyma very cellular and light throughout the apical parts, but becoming dense at the peripheral parts of the basal portions; surface covered with fine and short spinules.

This species is extremely close to the fossil species *Stylophora raristellata*, from which it differs in that the calicles are closer and are not margined by a solid ring-like edge. The styliform columella also is much less developed than in *Stylophora raristellata*. From the *Stylophora danæ*, to which it is closely allied, it may be distinguished by its less dense cœnenchyma, its narrower branches, its even calicles, which are neither distinctly raised at the margin nor furnished with a projecting upper lip, its much shorter, more thickened, and less developed septa, which throughout the greater part of the corallum, and especially at the basal portion, are distinct only at the bottom of the calicle, and do not take the form of the vertical plates characteristic of the older calicles of *Stylophora danæ*. The styliform columella is also absent, except in the extreme apical calicle, the centre being occupied by a broad concave mass, with which the septa are united, while in the *Stylophora danæ* a distinct styliform columella is

present, and is well developed towards the basal parts as a thick, pointed style placed above the small point of union of the septa.

Two specimens were obtained—one attaining a very great size.

Locality.—Samboangan, Philippines.

Family Pocilloporidæ.

Genus 1. *Seriatopora*, Lamarck.

Seriatopora, Lamarck, Hist. Anim. sans Vert., ii. p. 282, 1816.
„ Milne-Edwards and Haime, Cor., iii. p. 311.
„ Duncan, Rev. Madrep., p. 47.

An altogether new light has lately been thrown upon the structure of this genus by the researches of Professor Moseley.[1] It appears that the presence of a pair of deep lateral pits in the calicle must be regarded as an essential character in the definition of the genus as based on the corallum. As seen in several Challenger specimens, the degree of development of the septa, and the relation of these to each other and to the lateral pits, seem to vary considerably, not only in different species, but even in the different parts of the same specimen. Thus in *Seriatopora stellata* the six primary septa are large, well developed and exsert, and usually regularly arranged, so as to form equal interseptal chambers. In many calicles secondary septa are developed in the distal lateral chambers. The deep pits are always situated in the median lateral chambers, and no pits are to be found in either the distal or proximal lateral chambers. In the *Seriatopora conferta*, in the calicles on the basal part of the corallum, a condition closely similar to this is met with, while the secondaries are more developed; but in the calicles towards the apical parts of the corallum, where the fossa is very deep and the distal margin of the calicle arched, the septa are very slightly developed and often rudimentary, while the deep pits are situated at the proximal portion of the fossa and not at or towards the median portion. In the *Seriatopora crassa*, the septa are much less developed, but the proximal and distal lateral chambers in many of the calicles are much deepened and present an approach to the condition found in *Stylophora*, in which genus the six primary interseptal spaces are all deep. In this species, however, the proximal lateral chambers are often subdivided by secondary septa.

From those species of *Stylophora* with prominent calicles, in which a marked bilateral symmetry is present, species of *Seriatopora*, such as *Seriatopora stellata*, can be distinguished only by the presence of the two deep lateral pits.

Twelve species of this genus are in the collection.

[1] Notes on the Structure of Seriatopora, &c., *Quart. Journ. Micr. Sci.*, new ser., vol. xxii., 1882, p. 390.

1. *Seriatopora caliendrum*, Ehrenberg.

Seriatopora caliendrum, Ehrenberg, Cor. roth. Meer., p. 123.
„ „ Klunzinger, Cor. roth. Meer., p. 70, pl. vii. fig. 12; and pl. viii. fig. 3.

Specimens in the collection differ in no respect from the Red Sea forms. The branches are often very delicate, with slightly prominent or vaulted and rather deep calicles, which have a more or less well-developed pointed columella and distinct septa, which are more distinct towards the apical parts. The lateral pits are generally well marked.

Localities.—Samboangan, Philippines; and reefs, Fiji.

2. *Seriatopora valida*, Ehrenberg.

Seriatopora valida, Ehrenberg, Cor. roth. Meer., p. 123.
„ „ Milne-Edwards and Haime, Cor., iii. p. 313.

Some very fine specimens of this species were collected. The chief peculiarity of the species seems to be the great coalescence of the branches, which are at the same time much compressed, especially at their basal part, to form wide, subflabellate, reticulated pieces. The branches above tend to become parallel and are often much elongated; the calicles are small and in very distinct series, and the upper border is often distinctly prominent and vaulted, especially in those parts of the corallum that are not subject to abrasion.

Locality.—Samboangan, Philippines.

3. *Seriatopora gracilis*, Dana.

Seriatopora caliendrum, var. *gracilis*, Dana, Zoophytes, p. 522, pl. xlix. fig. 4.
„ *gracilis*, Dana, Coral and Coral Islands, p. 334.

The characters which separate this species from *Seriatopora caliendrum* are exceedingly slight. The corallum is more uniformly of a light texture, the cells are more distinctly and prominently vaulted, the septa are less distinct, and the columella more distinct and pointed towards the basal parts. Small specimens in the collection have the branches fistular, being bored throughout by one or more canals.

Locality.—Ternate.

4. *Seriatopora contorta*, Studer.

Seriatopora contorta, Studer, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, 1878, p. 541, pl. iii. fig. 12.

A single specimen in the collection evidently belongs to this species, though differing considerably in the size of the calicles from the description given by Studer. It seems

however, that the calicles are very rarely 1 mm. wide, the average size being scarcely more than 0·5 mm. Often they are scarcely or not at all prominent. In the extremely spinous nature of the branches, in this species limited to the upper portion, it approaches the *Seriatopora spinosa;* while the size and character of its cups and the compressed and coalescent nature of its branches relate it to *Seriatopora valida*, from which it seems scarcely justifiable to separate it.

Locality.—Samboangan, Philippines.

5. *Seriatopora cervina* (Lamarck).

Porites cervina, Lamarck, Hist. Anim. sans Vert., ii. p. 271, 1816.
Seriatopora cervina, Milne-Edwards and Haime, Cor., iii. pp. 312 and 314.
,, ,, Brüggemann, Ann. and Mag. Nat. Hist., ser. 4, vol. xix., 1877, p. 418.

Two small specimens in the collection I have referred to this species, with which they agree in essential structure. The cells are generally rather far apart, especially at the basal part, and this gives a rather dense texture to the corallum. The structure of these small specimens agrees exactly with that of the basal and outer branches of large specimens of the species. One of the small specimens, from Banda, has a very roughly echinulate surface and generally very small branches, but it agrees so closely in other parts that it can only be regarded as a peculiarly grown specimen of the same species.

The *Seriatopora compressa*, Studer, is very close to this species.

Localities.—Samboangan, Philippines; Banda.

6. *Seriatopora compressa*, Studer.

Seriatopora compressa, Studer, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, 1878, p. 541, pl. iii. fig. 11.

Two small specimens were collected which agree well with the description and figure of this species. In many calicles the upper margin, though finely divided, is not at all prominent. The septa are not perceptible except at the bottom of the cup, where a columella is present and is generally more developed and pointed in the calicles towards the apical parts of the branches; in the more basal calicles, the columella is broad, low, and scarcely marked, and the lateral pits are of very small dimensions, and often nearly obsolete. In general habit the species approaches the *Seriatopora valida*.

Locality.—Samboangan, Philippines.

7. *Seriatopora stellata*, n. sp. (Pl. II. figs. 4–4*b*).

Corallum closely ramose; the branches subequal, about 7 to 10 mm. thick, often coalescent, terete or slightly compressed where two or more coalesce, ascending, often

much divided and subdivaricate, especially at the outer parts; branchlets somewhat smaller than the branches, rather short and subacute, not winged at apex. Calicles generally crowded, rather shallow, quite small, about 0·5 or 0·75 mm. in diameter, regularly circular, irregularly placed, but often distinctly seriate near the apical parts, where the upper wall is generally rather arched and prominent; throughout the greater part of the corallum, especially towards the apical parts, the whole margin of the calicle is distinctly raised and rimmed, owing to the prominence and regularity of the marginal spinules, sixteen to twenty-four in number, which are often broad and septiform, and in the case of the larger ones are continuous with the septa which are developed within the calicle. Septa, generally six, extremely well developed at the sides and upper portion of the cup, but not distinct at the bottom of the fossa, broad, thickened and exsert, placed regularly apart with equal or subequal interseptal spaces; in many calicles two additional septa are present, situated one in each of the distal lateral chambers, but these septa are always very small and rudimentary. Columella conspicuous, compressed, narrow, styliform and pointed, projecting nearly to the margin. The two lateral pits are rather small and extremely deep, situated midway between the proximal and distal margin of the calicle. Texture compact; surface spinulose, the spinules being rather short and acute, though often thickened and long.

The thick and strong branches, the shallow calicles and subexsert columella, the great development of the prominent septa, together with the raised continuous marginal rim to the calicles will readily mark the species, which has much of the general habit of *Stylophora subseriata*, while in essential characters it seems to be allied to the fossil species, *Stylophora costulata*.

A single specimen was collected.

Locality.—Reefs, Fiji.

8. *Seriatopora ocellata*, Ehrenberg.

Seriatopora ocellata, Ehrenberg, Cor. roth. Meer., p. 122.
" " Milne-Edwards and Haime, Cor., iii. p. 313.
" " Studer, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, 1878, p. 540, pl. iii. fig. 10.

Two very fine and interesting specimens of this species were collected. In essential characters they agree in every respect, but the habit of growth differs considerably. In one the branches are much divided and coalescent at very short intervals, so that the clump becomes close and intricate; while in the other the branches are less divided and more elongated, coalescent at longer intervals, the aspect of the clump becoming more loose and elevated. The species is quite distinct from *Seriatopora spinosa*. The cells are very large and open, and at the base they are in indistinct series and are separated

by interspaces equal to their diameter; higher on the branches they become even larger, more distinctly seriate, with a very slight and angular, echinulate projection of the upper wall; at the extreme apical parts they are very distinctly seriate, oval or elongated, and 1·5 mm. in the long diameter, with very narrow divisions between them in the same series, and with extremely thin interseriate divisions. The septa and columella are almost indistinct, a narrow lamellate columella being generally present towards the apical parts. The ends of the branches are obtuse, thick, of very light texture, and very distinctly winged.

Locality.—Samboangan, Philippines.

9. *Seriatopora crassa*, n. sp. (Pl. II. figs. 3–3*d*).

Corallum large, heavy, forming broad and convex clumps of thick, rounded or slightly flattened branches which are much divided, intricately coalescent and obtuse. Branches about 1 cm. thick at base, often much wider at their point of coalescence, gradually lessening to about 5 to 7 mm. at about an equal distance from the apex, which is thick, rounded, and not winged. Throughout the entire corallum the branches dichotomise regularly at about every 5 to 7 mm. of their length, nearly at right angles, the larger number of the resulting very short branchlets coalescing with those of adjoining branches. Calicles subcircular or oval, generally small, about 0·5 mm. in diameter, slightly more towards the upper parts, where they often become nearly 1 mm. wide in the long diameter, scattered, and more or less indistinctly seriate at the base, where they are separated by spaces more than their own diameter in width, more closely placed and crowded on the apical parts, with spiral and linear series seldom distinctly and continuously marked even at the apex, prominent at the upper margin which is rounded, often oblique and finely divided. Septa of six primaries and rudimentary secondaries, seldom prominent, distinct only deep down in the cup where they are more or less rib-like. Columella well developed, conspicuous and pointed. Lateral pits in the median lateral chambers large and deep; generally four smaller and shallower pits well-marked in the other four primary interseptal spaces, of which the proximal pair are frequently subdivided by secondary septa. Surface very closely beset with fine spines, which sometimes form polygonal areas around the calicles. Texture very firm and compact.

This very distinct form has very much of the general habit of the intricately branched variety of *Seriatopora ocellata*. In essential structure it closely relates the genus to *Stylophora*, a decided approach being made to the distinct, deep primary interseptal spaces of that genus.

A single typical specimen was obtained, in which, however, a large part of the corallum has been injured by weathering.

To this same species another specimen has been referred, though very doubtfully. The specimen is characterised by the same robust habit, and its mode of growth is

exactly similar; but its essential structure differs in many particulars which may, however, be merely varietal. The calicles are larger and more distinctly circular, sometimes oval, with the long axis in the line of the branch, but very frequently perpendicular to it; the septa are less distinct; the proximal and distal lateral pits are generally scarcely marked; and the columella is much wider at its basal part, while its free projecting edge is thinner and sharper. For the present I distinguish it as *Seriatopora crassa*, var. *transversa*, though it seems almost justifiable to rank it as a distinct species, as *Seriatopora transversa* (Pl. II. figs. 3*c* and 3*d*).

Locality.—Mactan Island, Philippines.

10. *Seriatopora hystrix*, Dana.

Seriatopora hystrix, Dana, *Zoophytes*, p. 521, pl. xlix. fig. 3.

Two large and very fine specimens of this species were obtained. One possesses exactly the characters given by Dana; but the other differs in not having the branchlets of the central parts elongate, and subparallel as in Dana's figure; on the contrary the branchlets are divaricately branched throughout and are generally very shortly subulate. The two specimens agree so closely, however, in other respects as to be inseparable. The latter variety seems to be very close to, if indeed distinct from, the *Millepora lineata*, Linnæus.

Locality.—Levuka, Fiji.

11. *Seriatopora aculeata*, n. sp. (Pl. II. figs. 2–2*c*).

Corallum forming a much branched, coalescent, irregularly spreading and subprostrate clump, the branches of which are very short and thick, and are terminated above by a very suddenly pointed spine; the branches and branchlets subdivide at very short intervals into two, three or more shoots, becoming much swollen at their point of origin, so as to resemble rounded knobs, on or about which the new branchlets develop. The diameter of the chief branches is about 8 to 10 mm., but often by the coalescence of several parts, very thick masses are formed. The swollen terminal knobs of the branches are from about 6 to 9 mm. in diameter, and they form the basal part of the shoots, which are from 3 to 8 mm. in length, very sharply acuminate, and strong. The calicles are rather large, about 0·75 to 1 mm. in diameter, very regularly circular and open, often unevenly distant and indistinctly seriate, but very distinctly arranged in six rows on the terminal branchlets, rather deep, with two extremely deep lateral pits; the upper walls are extremely prominent, evenly rounded, and very strongly and uniformly ribbed on the upper surface, the ends projecting at the edge of the wall. The calicles thus simulate very closely the reversed short open tubo-nariform calicles of a *Madrepora*.

The septa are generally quite indistinct, but are seen within as lines of fine spinules. The columella is well developed, compressed and pointed, minutely spinulous. The surface throughout is very abundantly spinulous, the little spines being often arranged in angular areas around the calicles; at the extreme apical parts of the branchlets the surface is generally more or less pitted and cellular.

This species has, like the *Seriatopora spinosa*, spine-like branchlets, but the two species differ altogether in the form and relation of the branches and branchlets, and in the form and characters of the calicles. In this species the short, sharp, and thick branchlets may be described as being more or less terminal, while in *Seriatopora spinosa* they are very numerously placed along the long axis of the branches and are small and thin. A single small specimen was obtained. Many of its branches are fistular, being bored throughout by one or more canals.

Locality.—Ternate.

12. *Seriatopora conferta*, n. sp. (Pl. II. figs. 1–1*c*).

Corallum forming a rather light, much ramified, intimately coalescent, densely crowded and rather broad clump, in which the branches are divaricately divided at very short intervals. Branches about 5 mm. thick at their widest part, rounded and lessening slightly towards the apical parts; branchlets quite short, about 3 mm. thick at their base, obtusely rounded and not winged at the apex. Calicles generally circular, often oval towards the base, small, about 0·5 mm. wide, extremely deep especially towards the upper part of the corallum, distinctly seriate and crowded except towards the base; the upper wall usually prominent and rounded, arched forwards so as to make the fossa very deep and curved within, finely ribbed on its upper surface, and closely fringed at the margin with fine long spinules. Septa usually distinct and well developed, especially conspicuous in the shallower cups at the base, where they often form six slightly exsert, rather broad and thick lamellæ with rudimentary secondaries irregularly developed; towards the apical parts, the septa are much less distinct, the six primaries becoming quite small and often rudimentary, visible only as small markings deep down in the fossa, while the edge of the calicle becomes very distinctly margined by very fine and sharp elongated spinules. Columella well developed, compressed and pointed, but not conspicuous except in the basal calicles, being situated far down in the deep fossa in the other calicles. Lateral pits large and very deep, situated close to the proximal end of the fossa in the deep calicles; towards the basal parts they become more median. Surface delicately spinulose, the spinules being long and very fine.

The general habit and mode of branching, the nature of the branches and branchlets, and the essential structure of the calicles will easily serve to distinguish this species. Two rather large specimens were collected, in one of which the septa are much more

developed than in the other, especially towards the apical parts. In both specimens many of the branches are fistular, being bored by one or more canals; and owing to this, and to the thinness of the branches and branchlets, and to the deep and crowded calicles which cover them, the corallum becomes comparatively light.

Locality.—Kandavu, Fiji.

Genus 2. *Pocillopora*, Lamarck.

Pocillopora, Lamarck, Hist. Anim. sans Vert., ii. p. 273.
„ Milne-Edwards and Haime, Cor., iii. p. 301.
„ Duncan, Rev. Madrep., p. 47.

The real affinities of this genus were first determined by Verrill,[1] and confirmed by Professor Moseley, to whose research we are indebted for a more complete knowledge of the soft parts.[2]

Fourteen species of this genus were obtained.

1. *Pocillopora acuta*, Lamarck.

Pocillopora acuta, Lamarck, Hist. Anim. sans Vert., ii. p. 274.
„ „ Milne-Edwards and Haime, Cor., iii. p. 302, pl. F. 4, fig. 2.

This species is extremely variable in the shape and thickness of the branches and branchlets and in the size of the calicles. The branches and branchlets may be subterete or slightly compressed and angular, acutely or nearly obtusely rounded at the end, thick and strong or rather slender, of very close and shrubby habit or elongated and subarborescent, of very dense and compact structure throughout or open cellular within. The calicles are always crowded, with the interspaces generally marked by fine lines which surround the calicles, towards the apical parts the interspaces become extremely narrow and the linear markings are absent; the diameter of the cups is generally about 0·5 mm. to 1 mm. or more (in the type specimen of Lamarck the calicles are very small); the septa are more or less distinct especially in the apical parts, and are seen as minutely spinulous lines when magnified; the columella is distinct and forms a sharply convex spinulous projection elongated in the long axis of the branch. The surface is very sharply echinulate.

According to these differences in habit and structure, individual specimens may appear specifically distinct from each other, while in a large series of specimens it will be found impossible to separate them by any constant character.

A very interesting variety of the species was obtained at Banda; in this the branches are often compressed, and are almost obtusely rounded above and of very shrubby growth; the calicles are quite large and are scarcely crowded at the basal parts; the cœnenchyma is

[1] *Proc. Amer. Assoc. Adv. Sci.*, 1867.

[2] *Quart. Journ. Micr. Sci.*, new ser., vol. xxii., 1882.

scarcely compact even at the base, thus giving a very light texture to the corallum; the spinules of the surface are very fine, long and sharp. Though apparently so distinct from the ordinary form of the species, it is impossible to separate it, since a large specimen from Amboina furnishes more or less intermediate characters between it and the more commonly occurring form. It may, however, be distinguished as the *Pocillopora acuta*, var. *fragilis*.

The *Pocillopora ramiculosa*, Verrill, does not seem to be distinct from this species.

Localities.—Banda; Amboina; Mactan Island, Philippines.

2. *Pocillopora paucistellata*, n. sp. (Pl. I. figs. 3–3*a*).

Corallum ramose, lax; consisting of few rather thick, terete or subtercte, elongated, spreading branches, more or less prostrate and divided, which diminish gradually in size and give off at intervals comparatively few, small, subacute, short branchlets. Calicles large, about 1 mm. or more in diameter, very shallow and open, circular or slightly oval, never crowded even at the apical parts, separated by broad interspaces which are not marked by lines surrounding the calicles. Septa absent or quite indistinct even when the calicles are magnified. Columella absent, the bottom of the cup being finely spinulous and flat or subconcave. Surface often nearly smooth, unevenly marked by very short and rudimentary spinules, which are more distinct at the edge of the calicles, cœnenchyma extremely compact throughout.

This species resembles generally the *Pocillopora acuta*, but differs from it in its much more lax and elongated habit, in its distant and shallow cells, which are never crowded even at the apex, and the absence of septal markings and of a columella, and in the very short and rather distant spinules of the surface, which consequently appears almost smooth.

Locality.—Ternate.

3. *Pocillopora suffruticosa*, Verrill.

Pocillopora suffruticosa, Verrill, Bull. Mus. Comp. Zoöl. Cambridge, U.S.A., vol. i. p. 60.

A large and interesting specimen was obtained which agrees well with the short and incomplete description of Verrill. The clump is densely branched with many large, clustered, elongated, subtercte stems, which frequently divide and subdivide, the resulting branches being very proliferous throughout their whole length, and crowded with short branchlets. The calicles are small, 0·5 or 0·75 mm. wide, circular or oval and rather deep, separated by spaces less than their diameter.; the septa are developed, and in the calicles on the branchlets are distinctly seen, when the calicle is magnified, as finely spinulous lamellæ, which are less marked in the calicles on the main branches; the upper and lower septa in each cup slightly enlarged. Columella small, rather prominent.

The species is close to the *Pocillopora cespitosa*, from which it can be distinguished by its more fruticose habit, its small cells, and the developed septa and columella. It is extremely close to the *Pocillopora gracilis*, which agrees with it in all essential particulars, and, differing only in the more slender habit, seems thus to be only a variety of the species.

Locality.—Tongatabu.

4. *Pocillopora cespitosa*, Dana.

Pocillopora cespitosa, Dana, Zoophytes, p. 525, pl. xlix. fig. 5.
„ „ Verrill, Proc. Essex Inst., vol. vi. p. 91.

This species is exceedingly close to the *Pocillopora brevicornis*, though according to Verrill it is distinct from it. The typical form can readily be distinguished by its large cells (about or more than 1 mm. in diameter) and its thinner and more irregularly placed branches; while the *Pocillopora brevicornis* is at the same time marked by its small cells (much less than 1 mm.) and its thickened, short, stumpy and close branches and branchlets. Not infrequently, however, the species takes on the short, suppressed growth of the *Pocillopora brevicornis*, when its cells become markedly smaller, and in this form it is extremely difficult to determine between the two species.

A fragment from Tahiti, which is not separable from this species, is peculiar in the great size and depth of its calicles. These are occasionally as much as 2 mm. in diameter.

Localities.—Reefs, Honolulu, and at depths from 1 to 2 fathoms; Tahiti.

5. *Pocillopora brevicornis*, Lamarck.

Pocillopora brevicornis, Lamarck, Hist. Anim. sans Vert., ii. p. 275.
Dana, Zoophytes, p. 526, pl. xlix. fig. 8.

A very fine specimen and some fragments were obtained. In many parts of the corallum the branches become rather slender and elongate, and take on the characteristic shape of the *Pocillopora bulbosa*, from which it is thus difficult to separate the species.

Localities.—Api, New Hebrides; reefs, Fiji.

6. *Pocillopora damicornis* (Esper).

Madrepora damicornis, Esper, Pflanz. Forts., i. p. 43; Madrep., pl. xlvi. A.

A single rather large and more or less rounded clump was obtained, which agrees very closely with the figure and description given by Esper. The basal calicles are circular,

about 1 mm. in diameter or more, rather shallow, and separated by interspaces rather less than their diameter; the distal calicles elongated and irregular, rather larger, deep and very close, separated by very narrow walls. When strongly magnified they are seen to be very finely spinulous within, and in many of the apical cups the septa are very finely marked and represented by spinulous striations. The columella is scarcely developed, round, and spinulous.

Locality.—Samboangan, Philippines.

7. *Pocillopora danæ*, Verrill.

Pocillopora favosa, Dana (*non* Ehrenberg), Zoophytes, p. 528, pl. 1. fig. 1.
Pocillopora danæ, Verrill, Proc. Essex Inst., vol. vi. p. 93.

A small specimen of this species was collected. Except in the extreme apical calicles, the septa are represented by fine and often elongated spinules, which are also present on the scarcely distinct columella.

Locality.—Samboangan, Philippines.

8. *Pocillopora solida*, n. sp. (Pl. I. figs. 4–4*d*).

Corallum consisting of rather elongated, subarborescent, much divided branches which dichotomise regularly at intervals of about 15 mm., often divaricate; they are nearly equal throughout, verrucose, subterete or slightly compressed, being about 15 mm. wide and 10 mm. thick, slightly more towards the base. The verrucæ are very short, very unequal, irregularly placed, rarely crowded, generally separated by spaces more than their own diameter; they consist usually of two, three, or four large cells, rarely more, which are often barely raised above the surface; they are not found on the summits of the branches except on those towards the basal parts, where they are often longer and more irregular; they are absent on the basal part of the main stem and are more or less obsolescent on its upper portion and on the basal part of the smaller branches. Cells on the verrucæ quite large, about 1·5 mm. wide, deep, circular, with very elongated spinules on the upper margin, the spinules of adjoining calicles being placed in rows and continuous with the septa within; between the verrucæ and on the basal parts they are neatly circular, rather deep, generally quite small, 0·5 to 0·75 mm. in diameter, rarely more, rather closely placed above but generally separated by spaces more than their own diameter, especially towards the basal parts; on the apex of the upper branches the cells are subpolygonal and very closely placed. The septa are very slightly developed, and, when the calicles are magnified, are seen as minutely spinulous striations, which are more distinct in the cells on the verrucæ, where the uppermost septa are quite distinct. Columella inconspicuous and rounded or quite absent. Cœnenchyma

very compact, except on the apical parts of the upper branches; surface with very short and minute spinules, which are rather scattered and wide apart, except on the verrucæ, where they become longer and closer.

In the apical subpolygonal calicles of this species the tabulæ can be very easily traced. In these cells the septa are but slightly developed, and the tabulæ originate as slight ring-like thickenings within the calicle at some distance from the edge. By the concentric growth of this thickening a complete floor is formed which shuts in a wide intertabular chamber below. According to the stage of development of the tabula the central portion may be pierced by an opening of greater or less extent, which gradually lessens and eventually is altogether obliterated when the tabula is complete.

This species is very distinct from all other known forms, and is represented by a rather large specimen, which grew in a more or less horizontal position.

Locality.—Tahiti.

9. *Pocillopora ligulata*, Dana.

Pocillopora ligulata, Dana, Zoophytes, p. 531, pl. l. fig. 2.

Two rather small specimens were collected. They agree in all respects with Dana's excellent figure and description.

Locality.—Honolulu.

10. *Pocillopora plicata*, Dana.

Pocillopora plicata, Dana, Zoophytes, p. 534, pl. l. fig. 7.

The specimens which were referred by Dana to this species have been separated by Verrill,[1] the form from the Sandwich Islands being referred to a new species, *Pocillopora aspera*. Two specimens and some fragments in the collection, which apparently are identical with the *Pocillopora aspera*, agree so closely with the *Pocillopora plicata* that it seems necessary to reunite the two forms under their original name. The outer branches of the species are not at all plicate, but are more or less straight, elongated, and compressed.

Locality.—Reefs, Honolulu, at depths of 1 to 2 fathoms.

11. *Pocillopora nobilis*, Verrill.

Pocillopora verrucosa, Dana (*non* Ellis and Solander), Zoophytes, p. 529, pl. l. fig. 3.
„ *nobilis*, Verrill, Proc. Essex Inst., vol. vi. p. 97.

Two fine specimens and numerous fragments of the species were obtained. In one specimen the branches are often quite thin, though generally broad, while in the other

[1] *Proc. Essex Inst.*, vol. vi. p. 93–96.

they are much enlarged. The verrucæ are generally very crowded, small, short, and angular; the calicles when strongly magnified are seen to be distinctly stellate, with the septa numerously and finely spinulose, larger towards the centre; the species is very close to the *Pocillopora verrucosa*, but seems to be distinguishable by the much smaller and shorter verrucæ, which are scarcely pronounced at the apex, by the much more distinct and more spinulose septa, and by the finer spinulation of the surface.

Locality.—Reefs, Honolulu, at depths of 10 to 40 fathoms.

12. *Pocillopora verrucosa* (Ellis and Solander).

Madrepora verrucosa, Ellis and Solander, Zoophytes, p. 172.
Pocillopora verrucosa, Milne-Edwards and Haime, Cor., iii. p. 305.

A single large specimen and a few fragments were collected. The species is well characterised by the crowded, large and much elongated verrucæ which are placed on all sides and on the apical parts of the branches. Towards the base the verrucæ become more swollen and rounded. The spinules of the surface are coarse and bluntly pointed, often cuneate; the septa are present as distinct striations, obsolescently spinulous; and the columella is large and slightly raised.

Locality.—Reefs, Honolulu, and at depth of 1 to 2 fathoms.

13. *Pocillopora squarrosa*, Dana.

Pocillopora squarrosa, Dana, Zoophytes, p. 530, pl. l. fig. 5.

I have with doubt referred to this species a single rather small specimen, which at the same time is very closely allied both to *Pocillopora nobilis* and *Pocillopora verrucosa*. It has the general habit of the species with the stout and short tuberculous verrucæ, but these become much smaller towards the apex. The characters of the calicles are as in *Pocillopora nobilis*, except that the columella is much more developed and rounded, and that the spinules within the cup are finer and much more numerous. The spinules of the surface are small, crowded and very sharply pointed. Possibly the three species may have to be united.

Locality.—Ternate.

14. *Pocillopora grandis*, Dana.

Pocillopora grandis, Dana, Zoophytes, p. 533, pl. li. fig. 2.

A single specimen of this species was obtained. The branches are very variable in thickness, being from 15 to 30 mm., sometimes swollen towards the apex, where division is taking place; the apex is broad and conspicuously naked, often uneven owing to the

division into smaller parts for new branches; the verrucæ are less crowded in this specimen than is usual in the species, being rather short and subequal, rarely elongating. The calicles are very close, separated by very thin interspaces, more wide apart on the verrucæ and on the basal parts of the branches where narrow septa and a pointed columella are developed. Cœnenchyma scarcely compact, except on the superficial basal parts and on the verrucæ.

Dana's figure "2 *a*" gives a very exact idea of the character of the branches near the apex, except that the intercalicinal spaces are rather wider than is usual.

Locality.—Tahiti.

Subsection ASTRÆIDA.

Family ASTRÆIDÆ.

Genus 1. *Cladocora*, Ehrenberg.

Cladocora, Ehrenberg, Cor. roth. Meer., p. 85.
„ Milne-Edwards and Haime, Cor., ii. p. 587.
„ Duncan, Rev. Madrep., p. 70.

Cladocora arbuscula (Lesueur).

Caryophyllia arbuscula, Lesueur, Mém. du Museum, vol. vi. p. 275, pl. xv. fig. 2.

A single specimen was obtained in shallow water. Pourtalès records that it is found in quantities on muddy shoals. An interesting fact is the occurrence of the same species in 10 to 20 fathoms as far south as Simon's Bay, Cape of Good Hope, recorded by Professor Moseley. Very good figures of the species are given by Agassiz, Florida Reefs, pl. iii. figs. 1–7.

Locality.—St. Thomas, West Indies.

Genus 2. *Galaxea*, Oken.

Galaxea, Oken, Lehrb. der Naturg., i. p. 72.
„ Milne-Edwards and Haime, Cor., ii. p. 223.
„ Duncan, Rev. Madrep., p. 118.

Eight species of this genus were obtained.

1. *Galaxea clavus* (Dana).

Anthophyllum clavus, Dana, Zoophytes, p. 403, pl. xxviii. fig. 3.

One living incrusting specimen and a few small dead and somewhat worn specimens, over which *Seriatopora valida* and *Millepora murrayi* have grown, seem referable to

this species. The clavate or cylindrical lobes are much less than two inches thick, sometimes being scarcely one inch. The species in its earliest form grows in an incrusting manner with short calicles.

Locality.—Samboangan, Philippines.

2. *Galaxea explanata*, n. sp. (Pl. IV. figs. 6–6*d*).

Corallum a large, spreading, rather thin, explanate mass formed by an abundant peritheca, with an even, undulate, upper surface in which the cells are very large, loose, and delicate. Calicles, subcircular, angular or polygonal according to the prominence of the larger costæ, small, uniformly from 3 to 4 mm. in diameter at the margin of the wall, rather scattered, about 5 to 8 mm. apart, cylindrical and subparallel, projecting about 5 to 8 mm. above the peritheca. Walls rather thin; costæ remote, thickened and prominent with sharp edges throughout the length of the calicles, those of the first cycle very prominent, those of the second less so, and those of the third cycle generally absent or very imperfectly developed. Septa very granulated, of two cycles complete, a third very small and often incomplete; those of the first cycle rather thick, exsert, projecting about 2 or 3 mm., those of the second much smaller and thinner and often unequal.

This form differs markedly from all the other known species of the genus. Its mode of growth is altogether unique.

Locality.—Levuka.

3. *Galaxea musicalis* (Esper).

Madrepora musicalis, Esper, Pflanz., i. p. 160; Madrep., pl. xxx.
Galaxea musicalis, Milne-Edwards and Haime, Cor., ii. p. 225.

A single rather large specimen of this species was collected. The costæ in many calicles are quite inconspicuous, the wall appearing smooth.

Locality.—Somerset, Cape York; 5 fathoms.

4. *Galaxea fascicularis* (Linnæus).

Madrepora fascicularis, Linnæus, Syst. Nat., edit. xii. p. 1278.
„ „ Ellis and Solander, Zoophytes, p. 151, pl. xxx.
Galaxea fascicularis, Milne-Edwards and Haime, Cor., ii. p. 227.

A single small specimen of this well-marked species occurs in the collection. It consists in great part of a dead corallum, which has been more or less covered by fresh growth, the calicles of which are mostly very small.

Locality.—Kandavu, Fiji.

5. *Galaxea aspera*, n. sp. (Pl. IV. figs. 5–5*d*).

Corallum broadly convex above, subcylindrical, with a very scant peritheca, the cells of which are small and closely placed. Calicles either subcircular and about 6 mm. in diameter at the margin of the wall, or oval, elongated and compressed, and about 9 mm. in the long diameter; elongato-turbinate, but many calicles at different parts of the corallum, and chiefly at the outer margin, very shortly and distinctly turbinate; raised above the peritheca for a large portion of their length, many being free for more than 2 cm., irregularly crowded, generally about 4 to 5 mm. apart, but often very closely placed owing to the development of many small calicles around some of the larger ones (apparently owing to injury). Walls neatly thin; costæ very prominent throughout the length of the free portion of the calicles, distinctly raised but less prominent in the substance of the peritheca, slightly thickened and sharp, those corresponding to the small septa more prominent than those of the larger, less raised at the basal part of the shortly turbinate calicles than at the upper portion. Septa of three complete cycles, a fourth being rudimentary in many of the larger cups, very exsert, projecting about 5 mm., sub-acute above and somewhat fragile, being easily broken away; those of the first and second cycles nearly equal, thickened slightly at the wall and reaching to the centre; those of the third cycle projecting nearly to the centre and quite thin.

This species, like the *Galaxea fragilis*, possesses broad and prominent costæ, but it differs from that form in being much rougher and less delicate throughout, in its larger calicles, in the size and arrangement of the septa and costæ, and in the nature of the peritheca.

In the great prominence of its septa it recalls *Galaxea fascicularis*, *Galaxea hystrix*, and *Galaxea cuspidata*. The *Galaxea fascicularis* may be distinguished by the denser and firmer texture, by the thick walls and septa, which are often very granulated, and by the slightly prominent costæ which are obsolete on the basal part of the calicle where the wall becomes smooth. *Galaxea cuspidata* is well distinguished by its extremely large and regularly turbinate calicles with very thick septa. *Galaxea hystrix* is distinguished by the thick and abundant peritheca, by the cylindrical non-turbinate calicles, which are remotely carinate exteriorly, the wall being nearly smooth except at the upper portion.

Locality.—Amboina.

6. *Galaxea ellisii*, Milne-Edwards and Haime.

Galaxea ellisi, Milne-Edwards and Haime, Cor., ii. p. 228.

The appearance of this species varies much with age. In the young state its colonies are broadly convex, with closely placed calicles, which are subcircular, oblong or much

elongated. The calicles are quite large at the central portions of the colony, and have a diameter of from 5 to 7 mm., some more elongated are about 9 mm. in length and 4 mm. wide; they are free for about 6 or 7 mm., and are quite smooth at their juncture with the peritheca. The first and second cycles of septa are subequal and slightly thickened, the other septa are quite small and thin. In the adult form the colony becomes more or less cylindrical and rises into stout columnar lobes, in which the calicles are smaller and more regular, and the septa more equally thin.

A fine, young specimen was obtained. A figure, which Milne-Edwards and Haime have referred to this species, is given by Ellis, Phil. Trans., liii. pl. xx. fig. 14, 1764.

Locality.—Mactan Island, Philippines.

7. *Galaxea tenella*, Brüggemann.

Galaxea tenella, Brüggemann, Journ. Mus. Godeffroy, vol. xiv. p. 203.

This species is very close to the *Galaxea ellisii*, especially to the young forms of that species. It appears to be distinguished, however, by its much more prominent costæ, its more regular calicles, generally much expanded at the margin, and its thinner more delicate septa.

A single young specimen was obtained.

Locality.—Amboina.

8. *Galaxea fragilis*, n. sp. (Pl. IV. figs. 7–7*d*).

Corallum broadly subcylindrical or irregularly convex, with an unequally developed but abundant peritheca, the cells of which are very large, loose, and delicate. Calicles very delicate and thin throughout, subcircular, oval or slightly elongated and compressed, about 4·5 mm. in diameter from margin to margin of the wall, often nearly 7 mm. in the long diameter of the elongated calicles, elongato-turbinate, projecting very unequally above the peritheca, and from about 5 to 10 mm. high, often about 6 mm. distant from each other, but generally closely crowded together, with scattered small calicles developing numerously at various parts (apparently where the corallum has been injured). Walls very thin throughout; costæ very prominent throughout the free portion of the calicles, very thin, those corresponding to the last complete cycle of septa wider than the septa to which they correspond, and more prominent than those corresponding to the larger septa. Septa of three complete cycles, a fourth very rudimentary, and only seen in a few larger calicles; all the septa are extremely thin and delicate, very exsert, projecting about 4 mm., but fragile and generally broken away, except in those calicles that are protected from friction; septa of the first and second cycles equal and projecting quite to the centre, those of the third cycle very narrow.

This delicate species has many points of resemblance with the *Galaxea cespitosa* (Esper), but it can be most readily distinguished by the remarkable development of the septa and costæ.

A single specimen was obtained.

Locality.—Amboina.

Genus 3. *Caulastræa*, Dana.

Caulastræa, Dana, Zoophytes, p. 196.

The genus *Eusmilia*, Milne-Edwards and Haime, does not seem to differ in any marked particular from this genus, which claims priority, and should therefore be retained.

Caulastræa distorta, Dana.

Caulastræa distorta, Dana, Zoophytes, p. 199, pl. ix. fig. 5.

The forms of this species are much branched, close and short clumps, the branchlets being generally quite short. The septa are often either nearly entire or very unequally denticulate and spinulous.

A fine specimen was obtained.

Locality.—Tongatabu.

Genus 4. *Euphyllia*, Dana.

Euphyllia, Dana, Zoophytes, p. 157.
„ Milne-Edwards and Haime, Cor., ii. p. 191.
„ Duncan, Rev. Madrep., p. 84.

Four species of this genus were obtained.

1. *Euphyllia glabrescens*, (Chamisso and Eysenhardt).

Caryophyllia glabrescens, Chamisso and Eysenhardt, Nova Acta Acad. Nat. Curios., vol. x. pt. 2, p. 369, pl. xxxiii. fig. 1, A. and B.
Euphyllia glabrescens, Milne-Edwards and Haime, Cor., ii. p. 192.

Several specimens of this species were obtained. In one form the corallum becomes much raised and the calicles quite elongated and very deep, while the septa are very broad and loosely arranged; in another the corallum is small and very low the calicles short and stumpy, and the septa much narrower and closer. An intermediate specimen compels their being assigned to the same species. Five cycles are almost constantly developed, though often incomplete.

Localities.—Banda; Somerset, Cape York, shore.

2. *Euphyllia rugosa*, Dana.

Euphyllia rugosa, Dana, Zoophytes, p. 166, pl. vi. fig. 3.
" " Milne Edwards and Haime, Cor., ii. p. 194.

A very fine and large example of this species was collected. The transverse wrinkles and the carinato-striate costæ throughout the length of the calicles serve as ready characters by which to distinguish it from the *Euphyllia glabrescens*, but a very close approach is made to it in the larger form of the latter species.

Locality.—Amboina.

3. *Euphyllia turgida*, Dana.

Euphyllia turgida, Dana, Zoophytes, p. 166, pl. ix. fig. 9.
Milne-Edwards and Haime, Ann. d. Sci. Nat., ser. 3, vol. x. p. 268, pl. vi. fig. 1.

This species is very variable in the shape and size of its calicles. They may be from about 2 to 8 cm. in diameter, and either circular, oval, triangular, or much elongated. The septa are very thin and numerous, and the axial cavity is rather shallow. An excellent figure is given by Milne-Edwards and Haime.

Locality.—Shore, Somerset, Cape York.

4. *Euphyllia striata*, Milne-Edwards and Haime.

Euphyllia striata, Milne-Edwards and Haime, Cor., ii. p. 194, pl. D. 2, fig. 1.

A single specimen of this species was obtained. It is very close to the low and stumpy form of *Euphyllia glabrescens*, but the calicles are much larger, more sinuous at the edges, and less frequently divided, and the septa are much more numerous.

Locality.—Shore, Somerset, Cape York.

Genus 5. *Physogyra*, Quelch.

Physogyra, Quelch, Ann. and Mag. Nat. Hist., vol. xiii., 1884, p. 293.

Corallum compound, form massive, of very light structure, having the calicles in long sinuous, more or less mæandroid series, with their walls fused throughout so as to form a simple, very thin line of separation between the series. Calicinal centres generally distinct, indicated by the curving of the septa. Costæ almost entirely absent. Epitheca very slightly developed. Septa thin, fragile, very prominent, distant; edge *entire*. Columella absent. Endotheca well developed, vesicular; the dissepiments continuous between the septa from the centre of the calicle to the wall, very convex above, rather far apart above each other, thus forming wide interseptal chambers. Owing to this great

development of vesiculate endotheca, the series of calicinal centres are separated by wide ridges, formed entirely by the thin wall and by the convex dissepiments which stretch from the centre to this thin wall.

This genus, which has been confounded by Milne-Edwards and Haime with *Plerogyra* will include not only the following species, but also the *Plerogyra lichtensteini* of those authors; the genus *Plerogyra* being limited to those forms in which the walls are not fused throughout so as to form a thin lamina, but in which the series remain distinct with their walls united below and separated above, except occasionally when two free growing ends meet, and grow together.

Physogyra aperta, Quelch (Pl. III. figs. 1–1*a*).

Physogyra aperta, Quelch, Ann. and Mag. Nat. Hist., vol. xiii., 1884, p. 294.

Corallum convex above; wall very thin, simple, sometimes almost rudimentary. Costæ very slightly developed, and then only at the margin of the series. The series of the calicinal centres open and shallow, in no part deep and narrow; the centres are often difficult to distinguish, owing to the uniform development of dissepiments along the series. Width of series about 16 mm., but at times more than 20 mm. The septa are from 2 to 4 mm. apart, very thin and very projecting, subequal except at the ends of the series where some are very small, fragile and easily broken away, leaving the vesicular dissepimental ridges almost bare. The dissepiments are thin, convex above, more or less fragile and easily broken away, about 3 mm. apart from those above or below at the wall, closer at their inner terminations, forming simple, wide, curved interseptal chambers.

The species is easily distinguished from the *Physogyra lichtensteini* (Milne-Edwards and Haime) by the nature of the calicinal centres which in that species are very deep and narrow.

Locality.—Banda.

Genus 6. *Pectinia*, Oken.

Pectinia (pars), Oken, Lehrb. der Naturg., i. p. 68.
„ Milne-Edwards and Haime, Cor., ii. p. 206.
„ Duncan, Rev. Madrep., p. 86.

The dissepiments in this genus are stated by Milne-Edwards and Haime to be very abundant, curved and oblique, sometimes simple but more often forming large vesicles. This, however, is misleading, for in the calicinal valleys very little can be seen of endotheca as viewed exteriorly, and it is only at the basal parts, as seen in section, that the endotheca can be made out. In young stages, therefore, no endotheca, or but very slight traces of it at the base, would be present.

Pectinia profunda (Dana).

Ctenophyllia profunda, Dana, Zoophytes, p. 172.

A single specimen was obtained having an elongated narrow form like a young specimen of *Manicina areolata*. It is about 8 cm. long and the sides are very undulate, so that closely approximated, lateral folds are formed, by the fusion of which, during development, the transverse ridges would arise. The pedicel of attachment is very small, and a dense epitheca seems to be present covering the corallum up to nearly 1 cm. from the margin, but this in reality is largely of foreign growth, as of small shells, worm tubes, and calcareous algæ, and must be very variable in different specimens at different localities. The costæ are sharp-edged, dentate, narrow, lamellate, radiating to the pedicel. The septa are thin, of three, four, or five sizes—many septa of higher orders being developed at the curved exterior margins of the series. The columella is lamellate, continuous, and joined at the sides by vermiform processes from the lower edge of the septa. No endotheca is developed as seen in the calicinal valleys from above, but in section rudimentary dissepiments are found at the basal parts of the centres.

The specimen is a young form; and, owing to the absence of the soft parts, and the continuity of the columella, it can only be concluded that the form is a compound one by the extremely sinuous edges of the corallum, through the lateral coalescence of which transverse ridges are already developing. It very closely agrees with the *Sphenophyllia flabellum*, Moseley, so much so as to lead me to think that that form may probably be a young example of the same species. Unfortunately, little or nothing is known of the young stages of any of the species of the genus.

Locality.—St. Thomas, reefs.

Genus 7. *Trachyphyllia*, Milne-Edwards and Haime.

Trachyphyllia, Milne-Edwards and Haime, Cor., ii. p. 340.
„ Duncan, Rev. Madrep., p. 82.

Trachyphyllia amarantus (Dana).

Manicina amarantum, Dana, Zoophytes, p. 189, pl. ix. fig. 1.

The specimens of this species differ not inconsiderably in the size of the calicinal series, in the state of development of the paliform lobe, and in the thickness of the septa, and consequently in the size of the denticulations of the costæ and septa. According to these differences, the specimens are strong and thick or comparatively delicate and thin.

Locality.—Mactan Island, Philippines.

Genus 8. *Mussa*, Oken.

Mussa, (pars), Oken, Lehrb. der Naturg., i. p. 73.
„ Milne-Edwards and Haime, Cor., ii. p. 328.
„ Duncan, Rev. Madrep., p. 82.

Five species of this genus were obtained.

1. *Mussa fistulosa*, Milne-Edwards and Haime.

Mussa fistulosa, Milne-Edwards and Haime, Cor., ii. p. 332, pl. D. 3, fig. 3.

Of this well-marked species a single large specimen was obtained. The septa are very variable in different parts of the specimen, sometimes being very thick and almost swollen, and, not infrequently, quite small and thin. A curious hard and thick styliform columella is formed in one cup, due to the lodgment of foreign matter in the calicle. The depth of the cups is frequently less than 1 cm.

Locality.—Kandavu, Fiji.

2. *Mussa multilobata*, Dana.

Mussa multilobata, Dana, Zoophytes, p. 182, pl. viii. fig. 2.

A single specimen of this species was obtained. In some parts a very strong epitheca is developed, while on others it is quite rudimentary, leaving bare the nearly smooth surface with its striate and rarely spinose costæ. The specimen described by Milne-Edwards and Haime under this name seems to be a different form, more closely allied to the *Mussa echinata* than to this species.

Locality.—Banda.

3. *Mussa echinata*, Milne-Edwards and Haime.

Mussa echinata, Milne-Edwards and Haime, Cor., ii. p. 337.

This species is close to the *Mussa multilobata*, Dana, but is readily distinguished by its very spiny wall, which is often much thickened, and by its more numerous and rather thinner septa. Often the series are very short, and, not infrequently, many calicles become isolated. A strong epitheca is occasionally present on many parts of the colony. The *Mussa multilobata*, Milne-Edwards and Haime, does not seem to be different from this species.

Locality.—Amboina.

4. *Mussa aspera*, Milne-Edwards and Haime.

Mussa aspera, Milne-Edwards and Haime, Cor., ii. p. 332.

The specimen of this species is poorly grown, and by no means presents the typical structure of the species; it is smaller throughout, more vesicular and less thickened. A good figure of the species is given by Milne-Edwards and Haime.[1]

Locality.—Somerset, Cape York, 5 fathoms.

5. *Mussa brueggemanni*, n. sp. (Pl. II. figs. 6–6*b*).

Corallum forming large hemispherical clumps in which the calicles are either isolated and distinctly separate throughout a greater or less portion of their length, or remain united forming rather short sinuous series. The width of the calicinal series is very variable, from 10 mm. to 30 mm., the edge of the calicles being often expanded; the width of the interspaces between the series about 12 mm., the diameter of the isolated calicles often about 30 mm. or more, and the depth about 15 mm., sometimes less. The costæ are often quite distinct, and marked with small spines, which are larger and more numerous near the margin of the calicles, but frequently the outer wall is only obscurely striated or quite smooth. Five cycles of septa are present, easily determined in the isolated calicles, a sixth cycle being quite rudimentary. The septa are thus usually close and crowded; the chief septa are thickened but never stout, very prominent above the edge of the wall, and divided to the very centre into numerous, long, sharp, slightly curved strong teeth, which are thicker and shorter above; the smaller septa are very thin and are furnished with long, narrow, sharp teeth. The columella is generally well developed and trabeculate. Endotheca low down in the cup. In transverse section the septa and dissepiments are seen to be very close and thin, and the wall but slightly thickened.

The species is close to the *Mussa cytherea* and has much of the appearance of a very attenuated form of *Mussa sinuosa*. One small specimen and several fragments were obtained, the fragments being taken from one large specimen which measured more than 5 feet in diameter.

The very closely crowded septa, which are divided throughout even to the very centre into long, sharp, and slender teeth, those towards the outer edge being somewhat enlarged, give a very characteristic appearance to the species and will readily serve to mark it. The species is named after the late Dr. Brüggemann who first recognised its specific distinctness, but did not describe it.

Locality.—Amboina.

[1] *Ann. d. Sci. Nat.*, ser. 3, vol. x. pl. viii. fig. 4.

Genus 9. *Symphyllia*, Milne-Edwards and Haime.

Symphyllia, Milne-Edwards and Haime, Cor., ii. p. 369.

The genera *Symphyllia*, *Isophyllia*, and *Ulophyllia* are accepted as defined by Milne-Edwards and Haime. They are closely related to one another, and to *Mussa* on the one hand and *Tridacophyllia* on the other, but their differences seem sufficiently well marked to rank them as distinct. Very different opinions have been expressed by different writers as to their relationship, and it is certain that in some cases the forms on which these opinions have been based have not been rightfully referred to the genus under which they were placed. It was thus a necessary consequence that the genus under which they were wrongly placed by a misinterpretation of characters, and the genus to which they should have been referred, should not seem distinct, and should therefore have been united.

The numerous species described by Duchassaing and Michelotti from the West Indies, and placed by them under the genus *Symphyllia*, are all forms of *Isophyllia*, and, as Brüggemann has stated, the genus *Symphyllia* is not found in the West Indies.

Pourtalès, keeping *Mussa* distinct, considered that *Symphyllia* and *Isophyllia* were synonymous, and retained *Isophyllia* to include them both.

Verrill, on the other hand, has maintained that *Isophyllia* is distinct from *Symphyllia*; while he has united *Symphyllia* with *Mussa*.

Brüggemann, following Verrill, united *Symphyllia* with *Mussa*, maintaining *Isophyllia* to be distinct from them; he, however, united *Isophyllia* with *Ulophyllia* under the latter name.

Duncan, following Pourtalès, regards *Mussa* and *Symphyllia* as distinct, but unites *Symphyllia* with *Isophyllia* under the former name, *Ulophyllia* remaining distinct.

It seems to me, however, after a careful study of a large number of species of the different genera, that the treatment of these genera given by Milne-Edwards and Haime is an accurate one; and they have therefore been all retained, with their original signification.

The essential distinction of *Symphyllia* from *Mussa* is to be sought in the nature of the wall. In *Mussa* the walls are normally distinct, a condition which, although most clearly seen in those colonies in which the calicles are rapidly isolated, is yet clearly evidenced in the development of the seriate forms in which the walls of the developing series are found to be free from those of neighbouring series. In *Symphyllia*, on the other hand, the walls throughout are simple, those of neighbouring series forming a simple, solid ridge between the valleys, and originating as such in the earliest stages of development.

The opinion that these two genera should be united, seems to have been based on the condition found in such a species as the *Mussa regalis*, Dana, in which the walls of the

series in the more central parts of the colony are found to be united. A careful examination shews, however, that this union is altogether a secondary process, arising not with the original development of the series, but later on, when, by their increase in size, their adjoining edges have been brought into contact at many points and have then coalesced, as it were, for want of space. This process of union can be directly traced in large specimens; and, in these, ample confirmation will be found in the presence of the larger or smaller openings of variable shape which have been left in many places where complete union has not yet taken place between neighbouring series. Towards the central parts of these large specimens, where the union due to this secondary process is most complete, the resulting ridges have all the superficial characters of the normally developed ridges of *Symphyllia*, with the exception that their course is often interrupted by the occurrence of the variable-sized apertures, which in some cases will be found to be extremely small or even on the point of being obliterated. The peripheral portions of all such colonies, moreover, shew clearly the normal *Mussa* growth.

The characters which separate *Isophyllia*, are discussed under that genus.

Two species of *Symphyllia* are in the collection.

1. *Symphyllia sinuosa* (Quoy and Gaimard).

Mæandrina sinuosa, Quoy and Gaimard, Voy. de l'Astrol., Zooph., p. 227, pl. xviii. figs. 4, 5.
Symphyllia sinuosa, Milne-Edwards and Haime, Ann. d. Sci. Nat., ser. 3, vol. x., pl. viii. fig. 7.

Two small fragments were collected which seem referable to this species. The corallum is rather light and cellular, and the ridges are narrower and less rounded than is common in the species.

Locality.—Samboangan, Philippines.

2. *Symphyllia acuta*, n. sp. (Pl. II. figs. 5–5*b*).

Corallum with the upper surface more or less flattened; costæ on the lower surface narrow and thin, denticulate. Walls simple throughout, leaving no furrow above, never much thickened, being about 2·5 to 3 mm. wide in a transverse section of the corallum. Calicinal series very irregular, often nearly straight, generally sinuous; two or more centres often placed in the breadth of the same valley, but always opposite the point of development of new ridges where the valleys are very wide. Width of the valleys from 15 to 20 mm., depth from 10 to 15 mm. The ridges are very uniformly angular, broad below, and becoming quite narrow and acute above, never broad and rounded. Septa narrow, rather thin, numerous, and closely placed, from 12 to 15 per centimetre, generally alternately large and small, with unequally small and sharp teeth which are somewhat thicker and longer at the upper part, but never become large and stout. Columella

very small, trabeculate. Endotheca low down in the cup, very abundant; dissepiments very thin.

This species resembles *Symphyllia agaricia* in many of its characters, but differs considerably in the width and depth of the valleys and in the size and number of its septa. The characters of its septa will readily distinguish it from *Symphyllia radians*.

A small broken specimen was collected.

Locality.—Banda.

Genus 10. *Isophyllia*, Milne-Edwards and Haime.

Isophyllia, Milne-Edwards and Haime, Cor., ii. p. 374.

Some of the opinions which have been held as to the affinities of this genus by different authors have been noticed under *Symphyllia*.

The genus is essentially separated from *Symphyllia* by the characters of its septa. In *Symphyllia* the septa are strictly of the type of *Mussa*, being very thin near the centre of the calicle and increasing in thickness outwards, till at the margin they are very thick; and correspondingly the teeth of the septa are very thick and long at the margin, becoming very thin and small or rudimentary within. In *Isophyllia*, on the other hand, the septa are subequal within and without, being never markedly and distinctly thickened at the margin of the calicle, although very prominent; while correspondingly the teeth are subequal throughout, and do not take on the *Mussa* type.

Eight species of the genus were collected.

1. *Isophyllia strigosa* (Duchassaing and Michelotti).

Symphyllia strigosa, Duchassaing and Michelotti, Mém. Cor. des Antilles, p. 70, pl. x. fig. 16.

A large and fine series of specimens of this species was obtained. Many of the specimens are very small and show somewhat irregularly the six lobes into which the simple calicle becomes at first divided, while others attain to a size of 12 cm. in diameter. They are nearly hemispherical, sometimes slightly concave at the base, with an epitheca unequally developed; the walls are wholly fused and thin, sometimes marked with a very narrow furrow above; the costæ on the outer wall are generally well developed, lamellar and spinulose; the calicles may be isolated or in series of from two to six centres, being from 15 to 25 mm. wide, and from 10 to 16 mm. deep; the septa are very thin in the young specimen, becoming thicker and more exsert in older ones; they are perpendicular or nearly so, more or less truncate and wide above and bear throughout their whole length subequal, long, acute teeth, which give a bristling appearance to the corallum; the columella is well developed; and the number of septa to the centimetre is very variable even in the same specimen, being from seven to thirteen according as the last cycle is developed or not.

The specimens which I have referred to this species present some very interesting variations, but there are no differences constant enough in them to warrant specific separation. At least two of them in the absence of the others would seem to be distinct, but with the others at hand it is impossible so to designate them, for the series presents almost every intermediate condition, while the characters are extremely variable—the least variable being that the border of the septa is approximately vertical and the upper portion more or less truncate.

Thus the corallum may be very convex and raised, or slightly convex and broad, with a diameter of about 12 cm.; the epitheca very rudimentary or more developed; the costæ very finely spinulose or unequally toothed; the wall very thin, or thick enough to show a small furrow above; the calicles separate, or in series straight or sinuous, scarcely or nearly separated, deep or comparatively shallow, wide or narrow; the septa thin or thickened, with long or short teeth, very close or rather far apart according to the greater or less development of the last cycle; and the columella slightly or much developed; while at the same time these differences are most irregularly marked on different specimens.

Three forms may be selected as showing the extremes of variation :—

a. One with a very regularly raised, convex corallum; thin walls; rather large and deep calicles in sinuous series of from two to six centres; thin, vertical and truncate septa; very sharp, long and rough teeth giving a jagged appearance to the calicle; columella well developed.

b. Another with a very raised, convex, somewhat oblong corallum; thick walls; large, deep calicles in nearly straight series with scarcely distinct centres; thick, scarcely vertical and truncate septa; sharp and rough teeth; columella well developed.

c. A third with a very broadly convex corallum; thin walls; small, shallow calicles, separate or tending to be so; thin, rather narrow septa, somewhat vertical and truncate; short, sharp and rather small teeth, and a slightly developed columella.

The *Symphyllia anemone*, Duchassaing and Michelotti, must, I think, be placed as a synonym of this species, and perhaps also the *Symphyllia aglæ*. The *Isophyllia rigida*, Verrill, as re-described by Pourtalès under *Isophyllia guadulpensis* seems also to be indistinguishable from the broad variety of the species. The *Madrepora lactuca*, Esper,[1] seems to be the above species, but I have taken the name of the later authors to avoid ambiguity and doubtful identification.

Locality.—Bermuda.

[1] Pflanz. Forts., i. Tab. xxxiii.

2. *Isophyllia fragilis* (Dana).

Mussa fragilis, Dana, Zoophytes, p. 185, pl. viii. fig. 7.

This species has been referred to the genus *Colpophyllia* by Milne-Edwards and Haime, but it has all the fundamental characters of *Isophyllia*, under which it has been placed by Verrill,[1] and it is close to the *Isophyllia strigosa* on the one hand and the *Isophyllia cylindrica* on the other.

It is peculiar in the form of the upper parts of the wall, which, in neighbouring cups remain distinct as two subparallel lines, the septa passing over and coalescing between them. The costæ are sublamellate and entire or very finely denticulate. The septa are thin, fragile, not perpendicular at the edge, very unequal, and prominent and rather distant; the teeth are long, fine, ragged, and irregular. The columella is generally very abundant and loosely trabeculate, and continued from centre to centre.

A single small specimen was obtained. The form figured as *Isophyllia dipsacea* in the Report on the Florida Reefs, plate vii. fig. 3, seems, from general appearance, to be a typical specimen of the species, although the details of the structure of the wall are not shown.

Locality.—Bermuda.

3. *Isophyllia australis*, Milne-Edwards and Haime.

Isophyllia australis, Milne-Edwards and Haime, Cor., ii. p. 375.

Of this species, the type of which is in the Paris Museum, two specimens were obtained, one of which is much abraded at the centre and on one side, and bears upon it a young form consisting of a single calicle, clearly of the same species. The corallum in this species is but slightly convex; the costæ are decidedly lamellate and delicately spinulose, very apparent beneath the rudimentary epitheca; the walls are simple and fused throughout; the septa though strong are thin and close, and the teeth are long and generally fine. The number of the septa to the centimetre is very variable according to the development of the last cycle, and may be from seven to twelve.

Locality.—Bermuda.

4. *Isophyllia dipsacea* (Dana).

Mussa dipsacea, Dana, Zoophytes, p. 184.

Of this species there are many specimens in the collection. Drawings of the species are given in the plates of the Florida Corals,[2] but I believe that the specimen figured on plate vii. fig. 3, is referable to *Isophyllia fragilis*, Dana, and not to the present species.

The specimens obtained can be somewhat approximately arranged in a series, of which the extremes are so far removed, that in absence of the intermediate ones, two

[1] Dana, Coral and Coral Islands, p. 328.

[2] *Mem. Mus. Comp. Zoöl.*, vol. vii. No. 1.

specific names would doubtless be applied to them. The very convex specimens of the typical form gradually pass to those with a much broader growth, which seem to be very close to, if not identical with, the *Isophyllia sinuosa*, Verrill. In these the convexity is very slightly marked, and the cells become more shallow and open and of smaller size, though this is very variable (1·5 to 3·5 cm.), while at the same time the septa are thinner. The slight furrow on the wall between the septa often becomes somewhat prominent, and marks an approach to *Isophyllia marginata* (Duchassaing and Michelotti). The columella in some is well developed, and in others rudimentary.

An interesting variety occurs in which many of the larger septa are much thickened, a variety that calls to mind the *Isophyllia cylindrica*, to which it is closely allied.

The *Symphyllia thomasiana*, Duchassaing and Michelotti, does not seem to differ in any respect from the present species.

Professor Moseley remarks that this species seems to thrive best in the shade.[1]

Locality.—Bermuda.

5. *Isophyllia marginata* (Duchassaing and Michelotti).

Symphyllia marginata, Duchassaing and Michelotti, Mém. Cor. des Antilles, p. 72.

This specimen, which is shortly pedunculate, differs from the description of Duchassaing and Michelotti in one chief particular, namely, that the columella is here but slightly developed, a character that would place it very close to the *Isophyllia helianthus* of those authors. It is very close to the *Isophyllia dipsacea*.

On one side the epitheca is fairly well developed, on the other scarcely present; the walls are always fused together up to the edge of the calicles, but flattened above and wide enough to leave a well-marked vacant space or furrow between the septa of adjoining calicles; the septa are rather exsert, thin and finely dentate; the calicles are rather small and shallow, with measurements somewhat larger than those given in the description; the number of the septa to the centimetre is very variable in different parts according to the presence or absence of the septa of the last cycle.

To this species I have referred, with some doubt, another specimen which is much more convex than the foregoing, with an irregularly developed epitheca, a more abundant columella, and thicker and rougher septa. It closely agrees with it, however, in the flattened wall of the series which gives the characteristic appearance to the species, and as the above differences are all in characters which are very variable in the same species, it seems justifiable to conclude that a larger collection of this species would yield forms with less divergence.

To this species also, it is likely, should be referred the *Isophyllia multilamella* described by Pourtalès in the Florida Reef-Corals,[2] of which the *Lithophyllia multilamella*, Duchassaing and Michelotti, seems to be only a young specimen.

[1] Notes by a Naturalist on the Challenger, p. 27.

[2] Illustr. Cat. Mus. Comp. Zoöl., No. iv.

Duchassaing and Michelotti have regarded this species as being closely allied to *Symphyllia grandis*, Milne-Edwards and Haime, but a comparison of the description of this species with that of *Symphyllia grandis* will shew that the two forms are quite distinct, and not referable to the same genus.

Locality.—Bermuda.

6. *Isophyllia cylindrica* (Duchassaing and Michelotti).

Symphyllia cylindrica, Duchassaing and Michelotti, Mém. Cor. des Antilles, p. 71.

A very fine series of specimens, apparently referable to this species, was obtained. The series shows clearly the different stages of growth, five specimens being simple, fixed forms, the youngest of which is about 5 mm. in diameter, circular, with very prominent septa and costæ and a rudimentary wall, with three cycles complete; and the oldest about 2 cm. in diameter with five cycles complete, slightly oval in shape, irregular on one side where gemmation is taking place. Another small specimen shews an advanced stage in the formation of the colony, there being two fully formed calicles and a third developing. The larger specimens are elongated and broadly pedunculate; on these an incomplete epitheca is present, and the walls are fused throughout but often flattened above, presenting a decided approach to *Isophyllia marginata*. The calicles tend to isolate themselves, but are generally in irregular series of from two to four. The septa are of very variable size, and generally much thickened, more especially the primaries and secondaries (more clearly seen in the young stages); the teeth are strong but not specially developed at the upper margin. There are about seven or eight large septa to the centimetre with often one or two very small additional ones. The columella is moderately developed, but not abundant, and not continued from centre to centre. The width of the calicles is about 20 mm. and the depth from about 8 to 10 mm.

A single rather small specimen, which does not seem distinct from this species, differs in being flattened, apparently free at the base, and in having thinner septa. The species is very close both to the *Isophyllia dipsacea* and to *Isophyllia marginata*, and there are a few forms which seem so nearly intermediate between them, that it is with much doubt that I have retained the species.

Locality.—Bermuda.

7. *Isophyllia knoxi* (Duchassaing and Michelotti).

Symphyllia knoxi, Duchassaing and Michelotti, Mém. Cor. des Antilles, p. 71.

This specimen agrees well with the description given by Duchassaing and Michelotti. The most striking feature is the degree of separation of the calicles, which tend rapidly to

isolate themselves. This is, however, very irregular. In certain parts, especially towards the outer portion of the corallum, the edges of the calicles are quite free, the fusion of the walls taking place about 5 mm. below the edge of the calicle, thus leaving a well-marked, rather deep furrow, which is more or less distinctly marked by subspinulose costæ; but towards the centre the fusion of the walls is often complete, and but a slight furrow is present between the septa from adjacent calicles. The size of the calicles is very variable, being from 3 to 4 cm. wide and from 1 to 1·5 cm. deep. The septa are unequal and thick, eight or nine to 1 cm., but smaller intermediate ones are often present. The teeth are much more marked at the middle part of the septa, becoming smaller near the edge of the calicle, and somewhat so near the columella. This last is always well developed.

The corallum in this specimen is somewhat turbinate, about 8 cm. high, 12 cm. long, and 9 cm. broad. A well-developed epitheca is present, rising to from 3 to 8 mm. from the border. The costæ are well marked near the calicles, and are subspinose.

Locality.—Bermuda.

8. *Isophyllia aspera* (Duchassaing and Michelotti).

Symphyllia aspera, Duchassaing and Michelotti, Mém. Cor. des Antilles, p. 71.

The specimen which I have referred to this species agrees in every respect with the short description as given by Duchassaing and Michelotti, and seems to be quite distinct from those obtained at Bermuda. The calicles are sometimes separate, but are more frequently in long and sinuous series, which contain from two to fifteen calicinal centres. These centres are easily distinguished by the thickening of the columella at these points and by the great development of pairs of opposite septa which enclose them. The calicinal valleys are rather shallow, being from about 7 to 10 mm. deep. The walls are strong and thick, marked with a small furrow between the septa of opposite sides, but not flattened at the top, their width is very variable, ranging from 15 to 30 mm., the greatest width being generally that of a terminal calicle of a series. The septa are prominent, nearly subequal, generally much inclined, but sometimes nearly perpendicular at their outer edges, with few, from four to seven, strong unequal teeth.

The specimen is a very large one, being about 15 cm. in diameter. A large portion of it has grown under unfavourable conditions, and the wall at that part has become less elevated, thicker and broader, the septa much less prominent and thicker, with shorter, more rounded, and almost suppressed teeth. On comparison with this portion of the specimen, it would seem that the *Symphyllia conferta*, Duchassaing and Michelotti, is but a variety of this species.

Locality.—St. Thomas, West Indies.

Genus 11. *Ulophyllia*, Milne-Edwards and Haime.

Ulophyllia, Milne-Edwards and Haime, Cor., ii. p. 377.

The genus *Ulophyllia* is distinguished from *Isophyllia* by the nature of the walls and septa. The walls are always thin, more especially at their upper portion, where they are often broken through. The septa, though prominent about the centre of the calicles, where they generally give rise to a more or less distinct, paliform lobe, are very narrow on the upper part of the wall, and often take the form of thickened striations, and on this part of the septa the teeth are reduced to very fine serrations or are quite absent. The ridges which are thus formed are very narrow and sharp at their upper part, and differ altogether from those formed by the thickened wall and prominent septa of *Isophyllia*.

The genus is very closely allied to *Tridacophyllia*, but is distinguished by the greater thickness and the less elevation of its walls, by the much greater distinctness and prominence of its septa, and by the fact that the calicinal centres are confined to the valleys, and are not found also on the basal parts of the high ridges as in *Tridacophyllia*.

Two species of the genus were collected.

1. *Ulophyllia aspera*, n. sp. (Pl. III. figs. 5–5*b*).

Corallum convex or flattened, covered up to the edge by a very thin epitheca, beneath which the finely denticulate costæ are very distinctly seen. Calicles very frequently isolated, but often arranged in small series, which very rarely have as many as five or six centres; the single calicles are from 15 to 25 mm. wide in their long diameter, oval, elongated or irregular; the calicles in series are separated from each other by large and strong septa, which meet from opposite sides of the valley, and are bordered by wide interseptal spaces. The width of the series is from 11 to 15 mm., and the depth from 8 to 12 mm. The walls are thin above and often broken through, with a very ragged appearance due to the projection of opposite septa above, thick and very strong below. The septa are of five cycles, the last cycle being incomplete in many orders, closely placed and unequal, often quite thin, especially in the shallower calicles, prominent below so as to form a broad, denticulate, paliform lobe, and rather prominent above with fine, unequal, and strong teeth. There are about eight septa to the centimetre along the series, but on the outer part of the corallum they are more numerous, often as many as fourteen. Columella very abundantly developed, of open trabeculate or closely interlaced tissue. Endotheca slight, seldom forming vesicular ridges; and then but very slightly developed and irregularly placed.

A large specimen of this species, about 16 cm. in diameter, was obtained. Owing to

the slight endotheca, the interseptal spaces are very deep and conspicuous around the porous mass of the columella.

Locality.—Banda.

2. *Ulophyllia cellulosa*, n. sp. (Pl. III. figs. 6–6c).

Corallum convex above, flattened below, destitute of an epitheca, strongly and denticulately costate, with the intercostal spaces very abundantly and largely vesicular. Calicles sometimes placed singly, but generally arranged in long sinuous valleys in which the centres are very distinct, and always separated by the meeting of two large septa from opposite sides of the valley. Width of the valleys from 15 to 30 mm., depth often as much as 20 mm. Walls very thin, often broken through, much more raised at the central than at the outer part of the corallum where the cups are broad and shallow. Septa unequal, of four cycles, thin, very prominent below, and forming a distinct, central depression for the columella; much less prominent above and giving the ridges an acute edge, unevenly and rather far apart, being about six or eight to the centimetre on the top of the ridges, much more numerous and unequal in the outer and shallower cups, where there are often as many as thirteen to the centimetre; teeth of the septa rather large below, becoming very small or absent above, never becoming long and narrow, or bifurcating; a paliform lobe generally marked. Columella generally well developed, forming a rather large porous or trabeculate mass, but frequently scanty. Endotheca very abundantly developed as large, long, regularly placed, interseptal vesicles, which give a very swollen, convex appearance to the ridges at their lower portion and for some distance above the position of the columella, equal to about half the height of the ridges, the wall being continued above this swollen portion as a narrow lamina.

In appearance the single specimen in the collection has a general resemblance to the figure of *Madrepora lactuca*, Esper.[1] This species is easily separated from the *Ulophyllia aspera* by the abundantly developed endotheca which here gives rise to a swollen, raised ridge between the valleys in which the centres are placed. This ridge, formed by the large dissepiments between the septa, is more clearly seen when the prominent septa are broken away. A transverse section of the ridge to the level of the columella shows the thin wall with opposite septa, on the lateral surfaces of which are the thin interseptal dissepiments, which form long, curved chambers, and which extend above the columella for about one-half the height of the ridge. Other characters which serve to separate it from the same species are the much thinner walls; the wider, deeper, and more continuous valleys in which the centres are placed; their regularly and less sharply toothed septa; the more scanty columella; and the absence of a distinct epitheca on the vesicular costæ.

Locality.—Banda.

[1] Pflanz., Madrep., Tab. xxxa.

Genus 12. *Tridacophyllia*, Blainville.

Tridacophyllia, Blainville, Dict. d. Sci. Nat., lx. p. 327.
„ Milne-Edwards and Haime, Cor., ii. p. 380.
„ Duncan, Rev. Madrep., p. 94.

Tridacophyllia manicina, Dana.

Madrepora lactuca, Ellis and Solander (*non* Pallas), Zoophytes, p. 158, pl. xliv.
Tridacophyllia manicina, Dana, Zoophytes, p. 196.

The figure given by Ellis is a very good one, and will serve easily to identify the species. The walls are very unequally interrupted, often much broken through, and at other times quite continuous. Some fine specimens were obtained, and also a few pieces. The species is common in the East Indies but does not occur in the West Indies.

Localities.—Amboina; Ternate; Banda.

Genus 13. *Diploria*, Milne-Edwards and Haime.

Diploria, Milne-Edwards and Haime, Cor., ii. p. 401.
„ Duncan, Rev. Madrep., p. 87.

Diploria cerebriformis (Lamarck).

Meandrina cerebriformis, Lamarck, Hist. Anim. sans Vert., ii. p. 246, 1816.
Diploria cerebriformis, Milne-Edwards and Haime, Cor., ii. p. 402.

Of this very common species only a single, rather small specimen was obtained. It is about 15 cm. in diameter at the base, and about 9 cm. high. Professor Moseley remarks that it appears to prefer to grow where the water is lighted up by sunshine, and is conspicuous at the bottom as a bright yellow mass.[1]

Locality.—Bermuda.

Genus 14. *Manicina*, Ehrenberg.

Manicina, Ehrenberg, Cor. roth. Meer., p. 101.
„ Milne-Edwards and Haime, Cor., ii. p. 397.
„ Duncan, Rev. Madrep., p. 88.

Manicina areolata (Linnæus).

Madrepora areolata, Linnæus, Syst. Nat., ed. 12, p. 1272.
Manicina areolata, Milne-Edwards and Haime, Cor., ii. p. 398.

Milne-Edwards and Haime state that the septa are about fifteen to the centimetre and that there seem to be three cycles developed, but there are often as many as twenty

[1] Notes by a Naturalist on the Challenger, p. 27.

to the centimetre according to the development of a fourth cycle. Pourtalès, who had ample opportunity of examining numerous specimens in every stage of development, was of opinion that there was but one species of the genus to be found in the West Indian fauna.[1] Excellent figures are given in the Report on the Florida Reefs, plates v., vi.

Localities.—(1) St. Thomas, West Indies. A single specimen from shallow water on the reefs.

(2) Simon's Bay, Cape of Good Hope. A single specimen from 10 to 20 fathoms.

Genus 15. *Mæandrina*, Lamarck.

Meandrina, Lamarck, Hist. Anim. sans Vert., ii. p. 244, 1816.
Mæandrina, Milne-Edwards and Haime, Cor., ii. p. 388.
„ Duncan, Rev. Madrep., p. 88.

Three species of this genus were obtained.

1. *Mæandrina labyrinthica* (Ellis and Solander).

Madrepora labyrinthica, Ellis and Solander, Zoophytes, p. 160, pl. xlvi. figs. 3, 4.
Mæandrina labyrinthica, Dana, Zoophytes, p. 256, pl. xiv. fig. 1.

A single almost hemispherical specimen, about 14 cm. in diameter, was obtained. The ridges are rounded, sometimes slightly truncate, with a slight furrow. The walls are very thick and hard; the septa are rather thick and very broad, nearly meeting those of opposite sides at the bottom of the gyri, and rarely marked with a paliform lobe; at distances of from 3 to 5 mm. along the gyri, paired opposite septa enlarge slightly and apparently separate the calicinal centres. The columella is narrow, subporous or trabeculate. The width of the gyri is from about 7 to 9 mm. and the depth from about 5 to 6 mm.

Apparently the species is subject to great variation, the ridges becoming more or less triangular, the columella abundant, and the paliform lobes distinct.

Very good drawings of the species are given in the Report on the Florida Reefs, plate ix. figs. 10 to 12.

Locality.—Bermuda.

2. *Mæandrina sinuosissima*, Milne-Edwards and Haime.

Mæandrina sinuosissima, Milne-Edwards and Haime, Cor., ii. p. 393.

A single small specimen of this species was obtained. It is attached to the under side of the "form *f*" of *Mæandrina strigosa*, a species to which it is very closely allied, and

[1] See Pourtalès, Deep-Sea Corals, pp. 72 and 73, where much interesting information will be found.

of which it may prove to be simply a very thick and hard triangular-walled variety. At the outer part of the corallum the ridges are rounded and much damaged.

Locality.—Bermuda.

3. *Mæandrina strigosa*, Dana.

Mæandrina strigosa, Dana, Zoophytes, p. 257, pl. xiv. fig. 4.

A most interesting series of twenty-nine specimens of this species was obtained. They are of all sizes from about 10 cm. in diameter to more than 30 cm., the largest being about 18 cm. high. They are either hemispherical, subglobose or broadly convex, oblong or reniform—the hemispherical being the prevailing form. The species is subject to very great variation, and there are at least three forms which, in the absence of the other intermediate ones, might have been considered distinct. Pourtalès has already pointed out this variability as seen in two of the Florida forms; one with rather narrow gyri, thin walls, paliform lobes distinct but not very prominent; the other with wider gyri, wall rather thick, sometimes flattened and slightly furrowed on the top, and paliform lobes very distinct. This second form had previously been referred by Verrill to *Mæandrina sinuosa*, Lesueur.

While it is possible to select five or six specimens from the series as being more or less distinct, it is advisable to remark that the characters by which they may be distinguished are extremely variable, as shown by other specimens, and even by the same specimen at the outer part of the corallum. The following five forms may be described in order to bring more prominently forward the great modification which the species may undergo :—

a. Gyri very deep, about 7·5 mm., with a width of from 6 to 8 mm.; walls thick; septa with free border vertical, paliform lobes very distinct, rather thick; width of ridges above the paliform lobes from about 4 to 5 mm.; columella very abundant, forming a continuous mass about 2·5 mm. wide.

b. Gyri very deep, about 7 mm., with a width of 6 mm.; walls very thin; septa with free border vertical, paliform lobes very distinct and thin; width of ridges above the paliform lobes about 3 mm.; columella very abundant, forming a continuous mass about 2·5 mm. wide.

c. Gyri rather deep, from about 5 to 6 mm., with a width of from 4 to 5 mm.; walls very thin; septa with free border vertical, paliform lobes very distinct, those of opposite sides almost meeting and hiding the columella, so as to give a shallow appearance to the valleys, but often widening out at very close distances for the calicinal centres, which at the sharp curves of the ridges are quite distinct; width of ridges above the paliform lobes about 3 mm., columella abundant, almost hidden by the paliform lobes.

Gyri of variable depth according to the projection of the lamellate columella, from about 3·5 to 6 mm., with a width of from 4·5 to 6·5 mm.; walls rather thick; septa with the free border nearly vertical, but more rounded than in the previous forms; paliform lobes scarcely represented except in a few septa from about 3 to 5 mm. apart, which become very projecting, so as almost to meet from opposite sides; width of ridges from about 4 to 5 mm.; columella not abundant, forming but a raised lamella with prolongations from the septa.

Gyri shallow, from about 3 to 4 mm., with a width of from 5 to 7·5 mm.; walls thick; septa with the free edge rounded from the edge of the wall to the paliform lobe; paliform lobes very distinct, more so than in all the others, almost meeting in the centre; width of ridges above the lobes very variable, from 4 to 5·6 mm.; columella not abundant, being a simple lamella more or less pressed upon by the paliform lobes, sometimes widening out and distinct at the sharp curves of the gyri where the calicinal centres are distinct.

Between these forms, which are apparently so distinct, there seems to be almost every intermediate combination of characters, and the width and depth of the gyri, the thickness of the wall, the nature of the septa, the development of the paliform lobe, the thickness of the ridge, and the structure of the columella are seen to be extremely variable and irregularly grouped in their combinations. One and the same specimen often presents marked differences in structure between its central and its basal parts; and the smaller specimens generally agree more closely with the basal than with the central portion of the larger ones.

One special variation in the direction of the gyri may be mentioned as exhibited most clearly in one specimen, which may be distinguished as "form *f*."

f. This form shows gyri which are nearly straight and parallel for distances of from 4 to 6 cm., and the ridges pass off on each side of a central, nearly straight, line almost like the veins in a leaf, curving very slightly to the outer part where they become sinuous. These nearly straight ridges are sometimes excessively thin, passing gradually into the outer thicker and stronger ones. The width of the gyri is from 4 to 8 mm., and the depth from about 4 to 6 mm.

The *Mæandrina serrata*, *Mæandrina crassa*, and *Mæandrina heterogyra*, of Milne-Edwards and Haime, do not seem to be distinguishable from varieties of this species. The *Mæandrina heterogyra* is clearly identical with the "form *f*;" the *Mæandrina crassa* corresponds with "form *e*," and is represented more or less closely on the outer parts of nearly all the varieties of the species; while the *Mæandrina serrata* takes its place in the series between "forms *a* and *b*" and "form *e*."

The species is very close to the *Mæandrina labyrinthica*, which it much resembles

in the broad ridged varieties. Very good figures of the species are given in the Report on the Florida Reefs, plate ix. figs. 6 to 9, but they have been taken from a variety in which the ridges are more or less triangular, an approach to which is present in "form *f*."

Locality.—Bermuda.

Genus 16. *Cœloria*, Milne-Edwards and Haime.

Cœloria, Milne-Edwards and Haime, Cor., ii. p. 411.
„ (subgenus), Duncan, Rev. Madrep., p. 89.

Cœloria has been considered a subgenus of *Mæandrina* by Professor Duncan, but, as defined and limited by him, it seems to me sufficiently characterised to rank as a distinct genus.

Four species of the genus were collected.

1. *Cœloria dædalina* (Dana).

Astræa dædalina, Dana, Zoophytes, p. 236, pl. xii. fig. 7.
Cœloria dædalina, Verrill, in Dana, Coral and Coral Islands, p. 329.

This species is very close to *Cœloria esperi*, which will most likely have to be united with it. It seems to be distinguished by its thicker, rougher, and more uneven septa, and by its shorter calicinal series, but these are very variable characters. In not a few parts of the corallum all the calicles are in very short series or single, and take on a very distinct astræiform appearance.

Two specimens were collected.

Localities.—Kandavu and other reefs, Fiji.

2. *Cœloria esperi*, Milne-Edwards and Haime.

Cœloria esperi, Milne-Edwards and Haime, Cor., ii. p. 417.
„ „ Klunzinger, Cor. roth. Meer., iii. pl. ii. fig. 6.

A broken specimen in the collection shows well the characters of this species. The wall is not vesicular but solid, often becoming slightly swollen towards the outer part of the colony.

Locality.—Kandavu.

3. *Cœloria stricta*, Milne-Edwards and Haime.

Cœloria stricta, Milne-Edwards and Haime, Cor., ii. p. 417.

A small specimen of this species was obtained. The depth of the calicinal valleys in many parts of the corallum is often much less than their width.

Locality.—Kandavu.

4. *Cæloria leptoticha*, Klunzinger.

Cæloria leptoticha, Klunzinger, Cor. roth. Meer., iii. p. 19, pl. ii. fig. 7.

A very large specimen in the collection differs from the description given by Klunzinger only in having a well-developed columella. The calicinal series are usually long and sinuous, but many single calicles are scattered among them. The wide and deep interseptal spaces on each side of the columella are very conspicuous. The walls are often broken through and are at times vesicular.

The *Cæloria spongiosa* (Dana) from the West Indies (?) is close to this species and appears to be distinguished only by the greater width and depth of the valleys.

Locality.—Tongatabu.

Genus 17. *Hydnophora*, Fischer.

Hydnophora, Milne-Edwards and Haime, Cor., ii. p. 418.
„ Duncan, Rev. Madrep., p. 97.

This name was apparently first applied to this genus by Fischer de Waldheim.[1]

Three species were obtained.

1. *Hydnophora microcona* (Lamarck).

Monticularia microconus, Lamarck, Hist. Anim. sans Vert., ii. p. 251, 1816.
Hydnophora microcona, Milne-Edwards and Haime, Cor., ii. p. 423

Several specimens of this common species were obtained.

On many parts of one and the same specimen there are considerable differences in the size and number of the septa, and also in the height and thickness of the monticules, which are sometimes swollen at the apex.

Localities.—Kandavu and other reefs, Fiji.

2. *Hydnophora demidoffi*, Fischer.

Hydnophora demidoffi, Fischer, Mus. Demidoff, iii. p. 295, pl. iv.
„ „ Fischer, Oryct. du Gouvern. de Moscou, p. 156, pl. xxxii.

The reference to the former work quoted is given by Fischer in the second, in which there is a very good figure of the species.

The specimen in the collection is a small one, and it has grown incrusting as a thin lamina over a foreign body. Its margin is free to a greater or less extent, but is not turned up. The little cones are much elevated, angular and sharp.

Locality.—Banda.

[1] See Milne-Edwards and Haime, *loc. cit.*

3. *Hydnophora tenella*, n. sp. (Pl. V. figs. 8–8*a*).

Corallum extremely thin, forming irregularly bent and undulate plates, which are neither incrusting nor thickened at the middle, nor lobate above. The under surface irregularly costate, being finely striated and furnished with a thin epitheca. On the upper more flattened surface the calicinal centres are generally very distinct, but become much less so on those parts which are bent downwards. Where the centres are distinct the septa are of three cycles, the last being incomplete, and the little cones or monticules are very low and broad, and almost rounded, having the septa which traverse them narrow and far apart, with wide vesicular interseptal chambers, formed by numerous well-developed dissepiments. At the centre of the calicles and in the valleys the septa are coarsely granulated, and give the appearance of a well-developed columella. The monticules may be conical or much elongated; and towards the margin they become sharp, angular, and rather narrow, and much more elevated than at the central portion of the colony. At the central portions the calicles in the same series are from about 4 to 5 mm. apart; the width of the monticules being from about 5 to 6 mm., and the height from 1 to 2 mm.

A single specimen was obtained.

The species is close both to the *Hydnophora exesa* and *Hydnophora demidoffi*, but is distinguishable by the free, contorted, thin, explanate habit, by the nature of the calicinal centres which are more clearly astræiform than in any other species of the genus, and by the wide, flattened and vesicular monticules.

Locality.—Samboangan, Philippines.

Genus 18. *Astræa*, Lamarck.

Astræa, Lamarck, Syst. Anim. sans Vert., p. 371, 1801.
Favia, Milne-Edwards and Haime, Cor., ii. p. 426.
„ Duncan, Rev. Madrep., p. 100.

Following Verrill, I have retained for this group Lamarck's *Astræa*, which undoubtedly claims priority over the *Favia* of Oken. The type of Lamarck, for which the name *Astræa* should have been retained, was the *Astræa rotulosa* of his first section and not the *Astræa* (*Siderastræa*) *galaxea* of the second, to which Oken applied it.

Ten species are in the collection.

1. *Astræa fragilis*, Dana.

Astræa fragilis, Dana, Zoophytes, p. 230, pl. xii. fig. 2.

This species is widely separated from the *Astræa dipsacea*, to which Dana had likened it, and which has since been referred by Verrill to the genus *Acanthastræa*.

The trabeculate columella is often very small, situated at the bottom of a narrow central depression, surrounded by the paliform lobes.

Locality.—Mactan Island, Philippines.

2. *Astræa pandanus*, Dana.

Astræa pandanus, Dana, Zoophytes, p. 222, pl. xi. fig. 2.

The specimen in the collection is small and convex. The calicles are remote at the outer part of the colony, with a broad furrow; the septa are of four cycles, the third being very small and narrow, and the fourth quite rudimentary, and represented generally only by one order; the paliform lobes are more or less distinct and acute.

Locality.—Banda.

3. *Astræa versipora*, Dana.

Astræa versipora, Dana, Zoophytes, p. 233, pl. xii. fig. 5.

At the central part of the corallum the cells are often incompletely sulcate, and the ridges quite narrow; the paliform lobes are very indistinctly marked and often absent; the septa are quite thin within, very unequal and thickened at the wall, and rough and raggedly exsert. A single specimen was obtained.

The *Astræa versipora*, originally described by Lamarck, is referable to the genus *Plesiastræa;* but it seems advisable to retain the name given by Dana to this present form, even though his identification of it with that of Lamarck was at fault, since it belongs to a genus different from that of the original description.

Locality.—Kandavu, Fiji.

4. *Astræa danæ* (Milne-Edwards and Haime).

Astræa porcata, Dana, Zoophytes, p. 226, pl. xi. fig. 5.
Favia danæ, Milne-Edwards and Haime, Cor., ii. p. 442.
Astræa danæ, Verrill, in Dana, Cor. and Cor. Islands, p. 329.

The intercalicinal spaces are much broader and more distinctly sulcate at the outer part of the corallum than within. The cups are often elongated and irregular.

A single small specimen was obtained.

Locality.—Reefs, Fiji.

5. *Astræa ordinata*, Verrill.

Astræa ordinata, Verrill, Proc. Essex Inst., vol. v. pt. 3, p. 34.

A single small specimen is referable to this species. As Verrill observes, it is closely allied to the *Astræa speciosa*, Dana, but seems sufficiently distinguished by its firmer

and less cellular structure, by its more distant and even cells, and by its thicker septa and costæ, which have finer denticulations.

Locality.—Mactan Island, Philippines.

6. *Astræa doreyensis* (Milne-Edwards and Haime).

Favia doreyensis, Milne-Edwards and Haime, Cor., ii. p. 432.

The unequally raised edges of the calicles and the broad ridges give a peculiar appearance to this species, which is thus easily distinguished from the *Astræa denticulata*, with which it has many points of resemblance. The calicles in which division is taking place, or is about to take place, are much elongated and often irregular, with a diameter of from about 10 to 12 mm.

Locality.—Banda.

7. *Astræa speciosa*, Dana.

Astræa speciosa, Dana, Zoophytes, p. 220, pl. xi. fig. 1.

A portion of a large specimen was obtained. Owing to the very light structure of the species, the upper portions of the exsert septa are often broken away, a somewhat ragged appearance resulting. I have followed Studer in keeping the species distinct from both *Astræa* (*Favia*) *okeni*, Milne-Edwards and Haime, and *Astræa* (*Favia*) *tubulifera*, Klunzinger.

Locality.—Banda.

8. *Astræa ananas* (Ellis and Solander).

Madrepora ananas, Ellis and Solander, Zoophytes, p. 168, pl. xlvii. fig. 6.
Favia ananas, Milne-Edwards and Haime, Cor., ii. p. 435.

A single small specimen was obtained, incrusting a piece of rock. In the young stages the species appears to be very close to the broad-walled form of *Astræa fragum*, and also closely resembles the *Astræa porcata*, Esper,[1] which is found in the East Indies.

Locality.—Bermuda.

9. *Astræa coarctata* (Duchassaing and Michelotti).

Favia coarctata, Duchassaing and Michelotti, Mém. Cor. des Antilles, p. 76, pl. x. figs. 17, 18.

The specimen which I have referred to this species consists of a small colony of five calicles, which was found growing on the base of a large *Mæandrina*. Two of these calicles are subcircular, while the other three are much elongated, and two of them show

[1] Pflanz. Forts., Madrep., pl. lxxi.

clearly the process of division. The short description applies closely to the specimen, and the figure of the entire corallum (fig. 17) well represents it, but the calicles, as seen in fig. 18, differ from it, and also from the description, in the absence of the well-marked teeth.

The corallum is incrusting, slightly convex, and with a well-developed epitheca; the calicles rather close, subcircular or elongated, rather deep, from 3 to 5 mm. long, 1 to 3 mm. wide, and about 2 mm. deep, borders free, with prominent toothed costæ connecting adjacent calicles. Septa in three complete cycles, a fourth rudimentary, thin, exsert, finely toothed and very granulated, the innermost parts confluent with each other and with the slightly developed columella.

Locality.—Bermuda.

10. *Astræa fragum* (Esper).

Madrepora fragum, Esper, Pflanz., i. Forts., p. 79; Madrep., pl. lxiv.
Favia fragum, Milne-Edwards and Haime, Cor., ii. p. 439.

The specimens of this species are very abundant on the shore; and are in every respect identical with the ordinary West Indian forms. The calicles attain very often a diameter of 8 mm., and are much more closely placed in the middle than at the margin of the colony where the walls are much thicker and the costæ conspicuous. In many of the largest calicles rudiments of a fifth cycle are often present.

Locality.—St. Vincent, Cape Verde Islands.

Genus 19. *Goniastræa*, Milne-Edwards and Haime.

Goniastræa, Milne-Edwards and Haime, Cor., ii. p. 444.
„ Duncan, Rev. Madrep., p. 102.

An extremely interesting modification of the pali is found in one of the species of this genus, *Goniastræa multilobata*, n. sp., in which these structures are often much divided and irregularly placed.

Eight species of the genus were obtained.

1. *Goniastræa multilobata*, n. sp. (Pl. III. fig. 2–2*c*).

Corallum incrusting at base, rising into short, thick, and broad, obtuse branches or lobes which become more or less coalescent laterally. Calicles very unequal and irregular, polygonal, oblong or much elongated, straight or sinuous. In the greater number of the calicles, especially on the apical parts of the branches, division is so rapid that many of them contain two, three or more centres incompletely separated from each other; and

where these are in the same line, the parent calicle becomes very long. The simple cells are from 5 to 10 mm. in diameter, and from 2 to 5 mm. deep. The walls are often 2 mm. thick and rounded, but generally they are thinner and somewhat acute. The septa are somewhat truncated above, exsert, narrow, thin, and irregularly denticulate, and give a ragged aspect to thecorallum; they are of three or four cycles, the last two being small and incomplete. The pali are very uneven and irregular, thin, elongated and generally much divided and denticulate. The columella of a few small shorter points often scarcely distinct from the pali. Endotheca abundant, dissepiments very small, thin and irregular.

This species recalls many of the characters of *Goniastræa planulata* and *Goniastræa coronalis*, andrepresents an extreme form of the genus.

Two large specimens were obtained.

Locality.—Amboina.

2. *Goniastræa eximia* (Dana).

Astræa eximia, Dana, Zoophytes, p. 242, pl. xiii. fig. 4.

A small but excellent specimen of this well-marked species was obtained. The walls are extremely compact, and the corallum in consequence very heavy. Those cells which are in process of division are often quite large, being about 6 mm. in diameter.

Locality.—Banda.

3. *Goniostræa cerium* (Dana).

Astræa cerium, Dana, Zoophytes, p. 245, pl. xiii. fig. 8.

This species has much of the appearance of *Goniastræa eximia*, but its calicles are much smaller and quite shallow. The diameter of the calicles is from about 3 to 4 mm., and the depth about 1 mm. The walls are solid and thick, marked with slightly exsert septa. The pali are small but distinct, and are placed on the larger septa. The third cycle is incomplete and small, and rudiments of a fourth cycle are present in the larger cups.

Locality.—Kandavu, Fiji.

4. *Goniastræa favistella* (Dana).

Astræa favistella, Dana, Zoophytes, p. 241, pl. xiii. fig. 2.

Only a fragment of the basal part of a specimen of this species occurs in the collection. The septa are of four cycles, the last being incomplete and very small; occasionally rudiments of a fifth cycle are to be found.

Locality.—Banda.

5. *Goniastræa quoyi*, Milne-Edwards and Haime.

Goniastræa quoyi, Milne-Edwards and Haime, Cor., ii. p. 447.

Two fine specimens were collected. The species is very variable in many of its characters, and this can be easily seen on different parts of the same specimen. The calicles may be deep or quite shallow and open; the walls may be rather thick or quite thin; the septa slightly exsert or included, appearing as narrow, oblique or erect lamellæ; the pali may be small and scarcely distinct or thick and well developed, and the columella may be trabeculate or finely spongy. Septa of the fourth and fifth cycles are often developed, but the latter are small and scarcely distinct.

Localities.—Banda; Somerset, Cape York, shore.

6. *Goniastræa grayi*, Milne-Edwards and Haime.

Goniastræa grayi, Milne-Edwards and Haime, Cor., ii. p. 447.

This species is very close to *Goniastræa quoyi*, but appears to be distinguished by the regularly deep calicles, by the closely crowded and extremely narrow, erect, numerous septa, by the thicker and stronger pali, and the more abundant spongy columella. The walls have a very even outline owing to the closely placed narrow septa. A small specimen was obtained.

Locality.—Mactan Island, Philippines.

7. *Goniastræa coronalis*, n. sp. (Pl. III. figs. 3–3*a*).

Corallum rather thin, explanate or slightly convex above, with the edges quite thin and trenchant; the under surface covered with a strong epitheca and radially ridged up to the margin, showing the course of the calicles. Calicles unequal and irregular, generally pentagonal, often elongated and in process of division, the larger diameter being from 10 to 18 mm., many small calicles interspersed between the larger ones, the depth of the calicles from 3 to 5 mm. Many cups quite shallow. Three, four or five cycles developed, the last cycle in each calicle being incomplete and very small; septa narrow, rather thin, a little exsert, projecting but little from the wall, which is strong, moderately thick, and not rounded above; the edge of the septa very closely and finely denticulate with sharp, short and simple teeth. Pali very large, distinct, and broad, often twice as broad as the septa, elevated, leaving a central depression between them which is occupied by a scant trabeculate columella, the upper border of the pali strongly denticulate.

This species resembles *Goniastræa planulata* in many of its characters, but is easily

distinguishable by the nature of the wall, the septa, and the pali. The characters of the pali will readily separate it from all other species.

A very fine but rather small specimen was collected.

Locality.—Banda.

8. *Goniastræa laxa*, n. sp. (Pl. III. figs. 4–4*d*).

Corallum incrusting, forming broad, convex spreading masses. Calicles oblong or polygonal, from 6 to 8 mm. in the long diameter, and from 3 to 5 mm. deep; walls generally quite thin and acute, rarely flattened and wide; septa very unequal, wide apart, of three cycles, those of the third cycle very small and often quite rudimentary, very seldom there are rudiments of a fourth cycle in some of the largest calicles; from about seven to nine large septa reach to the centre, surmounted by small, long, upright pali, which are scarcely distinguishable from paliform teeth, and surround a central depression in which there is no trace of a columella. The septa are exsert, slightly thickened at the wall, and finely and raggedly denticulate, giving a rough appearance to the corallum. Endotheca very abundant, visible above between the larger septa; the dissepiments small, very thin and close.

This species presents an interesting modification of the structure of the wall, the thick and flat form showing a very decided approach to the genus *Astræa*.

The species has also a very great resemblance to forms of the genus *Prionastræa*, and this is greatly increased by the slight development of the pali, which sometimes do not seem to differ in any respect from large paliform teeth. The increase by fission seems, however, to be evident in many parts of the corallum, though it is, confessedly, difficult in the dried condition to distinguish this from sub-central, intra-calicinal gemmation. It is possible, on this account, that this form will have to be referred to the genus *Prionastræa* when living specimens of the species have been examined.

Two specimens, one a fine and large one, were collected.

Locality.—Api, New Hebrides. One of the four most abundant reef-forming species in this locality.

Genus 20. *Acanthastræa*, Milne-Edwards and Haime.

Acanthastræa, Milne-Edwards and Haime, Cor., ii. p. 501.
„ Duncan, Rev. Madrep., p. 119.

Acanthastræa irregularis, n. sp. (Pl. IV. figs. 2–2*a*).

Corallum spreading, forming a thickened, convex plate. Epitheca well developed to the very edge, slightly wavy. Calicles unequal, subcircular, oblong or polygonal,

varying in size from about 14 to 20 mm. in diameter and from 5 to 8 mm. in depth; walls simple, often quite thin, generally thickened, slightly rounded, and about 2 mm., rarely 3 mm., wide. Septa unequal; very thin within the cup, with numerous, rather long, fine teeth; much thickened, and projecting but slightly at the edges, being from about 1 to 1·5 mm. thick, with slightly swollen fistular teeth, which are often nearly 2 mm. long; of five cycles in the large calicles, the last being quite incomplete and very small, distinct only on the sides; in the smaller calicles the fourth cycle is incomplete and small. As the small septa are not continued to the centre, wide and open interseptal spaces are seen, in the centre of which is a scant, papillose columella.

The species seems to take an almost intermediate position between the *Acanthastræa hirsuta*, Milne-Edwards and Haime, and the *Acanthastræa angulosa*, Brüggemann. From the former it is distinguished by the larger and shallower cells, by its thinner, nearly rounded, simple wall, and by the thinner, more numerous, and very unequal septa: from the latter, by its larger and deeper cells, by its thicker, more rounded wall, and by its more thickened, fistular, more equally prominent septa, which, being less crowded towards the centre, leave the endotheca clearly visible at the bottom of the wide, interseptal spaces. In the *Acanthastræa angulosa*, the larger septa are very irregularly and raggedly prominent above the thin wall, and give a striking appearance to the corallum.

A single rather small specimen only was collected.

Locality.—Kandavu, Fiji.

Genus 21. *Prionastræa*, Milne-Edwards and Haime.

Prionastræa et Metastræa, Milne-Edwards and Haime, Cor., ii. pp. 513, 525.
Prionastræa, Duncan, Rev. Madrep., p. 123.

This genus has been extended by Professor Duncan to include the *Metastræa* of Milne-Edwards and Haime.

Four species were obtained.

1. *Prionastræa flexuosa* (Dana).

Astræa flexuosa, Dana, Zoophytes, p. 227, pl. xi. fig. 6.

The cells are very irregular, often much elongated, curved and narrow, but deep; the ridges are scarcely or not at all sulcate: the septa of five cycles, the last imperfectly developed. The walls are often quite thin.

Locality.—Kandavu, Fiji.

2. *Prionastræa robusta* (Dana).

Astræa robusta, Dana, Zoophytes, p. 248, pl. xiii. fig. 10.

The cells on the apical parts of the lobes are deep, with very thin walls and narrow septa; on the basal parts the cells become shallow, with broader septa and thicker walls.

The species is very close to the *Prionastræa abdita* and probably will have to be united with it.

Locality.—Amboina.

3. *Prionastræa obtusata*, Milne-Edwards and Haime.

Prionastræa obtusata, Milne-Edwards and Haime, Cor., ii. p. 518.

The extremely narrow and thin septa, which appear as mere denticulate striations on the thick and compact walls, give a peculiarly open and naked appearance to the calicles. A fifth cycle is generally represented, but remains very imperfect and small.

Locality.—Kandavu, Fiji.

4. *Prionastræa quoyi*, Milne-Edwards and Haime.

Prionastræa quoyi, Milne-Edwards and Haime, Cor., ii. p. 519.

The walls in this species are very unequal. In many of the outer cups the walls are often from 3 to 4 mm. wide, and distinctly sulcate, and the septa are firm and rather thick; but generally the walls are thin, from 1 to 2 mm. wide, scarcely or not at all sulcate, and the septa are very thin, with subtrabeculate teeth. The fourth cycle is imperfectly developed.

Two specimens were collected.

Locality.—Reefs, Fiji.

Genus 22. *Plesiastræa*, Milne-Edwards and Haime.

Plesiastræa, Milne-Edwards and Haime, Cor., ii. p. 489.
„ Duncan, Rev. Madrep., p. 107.

This genus is extremely close to *Orbicella*, from which it is distinguished by the presence of pali. In those species of *Orbicella*, in which a strong paliform lobe is developed, it is a matter of great difficulty to distinguish these structures from the pali of *Plesiastræa*.

Two species are in the collection.

1. *Plesiastræa urvillei*, Milne-Edwards and Haime.

Plesiastræa urvillei, Milne-Edwards and Haime, Cor., ii. p. 490.

Of this species a small flattened specimen occurs, which differs from the ordinary form in having the calicles placed more widely apart, and the septa more prominent. The pali are generally unequal.

Locality.—Kandavu, Fiji.

2. *Plesiastræa indurata*, Verrill.

Plesiastræa indurata, Verrill, Proc. Essex Inst., vol. v., part 3, p. 35, pl. ii. fig. 7.

A single fine specimen is referable to this species. It is close to *Plesiastræa coronata*, but differs in its larger and deeper cells and its more numerous septa. Towards the outer part of the corallum the cells are very obliquely placed, as in *Plesiastræa coronata*.

Locality.—Kandavu, Fiji.

Genus 23. *Phymastræa*, Milne-Edwards and Haime.

Phymastræa, Milne-Edwards and Haime, Cor., ii. p. 499.
Duncan, Rev. Madrep., p. 106.

Phymastræa aspera, n. sp. (Pl. IV. figs. 1–1*b*).

Corallum massive, heavy, irregularly convex. Calicles rather large, very unequal and deep, polygonal, circular, oval or elongated, greatest width from about 9 to 11 mm., many calicles less, about 4 to 5 mm. deep; furrows between the calicles well marked, very narrow, with deep spaces between the connecting portions occupied by small tubes —apparently worm tubes—which preserve the intercalicinal spaces and keep them open during the growth of the colony; costæ unequal, denticulate, those of opposite cups often coalescing. Septa not perforated, of five cycles, the last being very rudimentary, the fourth being small; those of the three first cycles are subequal, large, and rather thick, much exsert, and roughly, unequally, and bluntly toothed; the innermost teeth are very distinct, large, long, and paliform, not divided, surrounding a distinct deep and narrow depression, at the bottom of which is a small, subtrabeculate or papillose columella which is almost absent in a transverse section. Texture of the corallum very dense and hard.

This species is represented by a single specimen. At the outer part, the cups become rather shallow and approach very closely to the form of those of *Phymastræa valenciennesi*. It is, however, distinguished from *Phymastræa valenciennesi* by its convex mode of growth, by its more distinct and prominent calicles which are also quite deep, by the much greater development of the septa, which are more exsert, numerous, and closely placed, not perforated, with non-bifurcated and large paliform teeth, and by the slight development of columella. From *Phymastræa profundior* it is distinguished by the large size and irregular growth of the calicles, and by the numerous septal orders, the septa being quite close, exsert and thickened, furnished with a very distinct, large, paliform lobe.

Locality.—Banda.

Genus 24. *Orbicella*, Dana.

Orbicella, Dana, Zoophytes, p. 206.
Heliastræa, Milne-Edwards and Haime, Cor., ii. p. 456.
„ Duncan, Rev. Madrep., p. 104.

Verrill[1] has pointed out that this name should be applied to this group rather than the later term *Heliastræa* of Milne-Edwards and Haime, which has been adopted by the generality of recent writers.

Orbicella cavernosa (Esper).

Madrepora cavernosa, Esper, Pflanz. Forts., p. 18, Madrep. pl. xxxvii.
Orbicella argus, Dana, Zoophytes, p. 207.
Heliastræa cavernosa, Milne-Edwards and Haime, Cor., ii. p. 463.

From the accurate descriptions given by Dana and by Milne-Edwards and Haime of this common West Indian form, the specimens obtained off Barra Grande, Brazil, differ but slightly in having the surface of the intercalicinal spaces vesiculate, causing the union of the costæ of adjoining calicles with one another to be indistinct, and also in having the septa more uniformly thickened throughout. It was obtained from a depth of 30 fathoms, and tends to prove that species of Coral, which are reef-building forms, live at much greater depths than is usually believed. The rounded masses, as stated by Professor Moseley in his journal, were about 2 feet in diameter at the flat base, and were extremely and regularly convex above. When broken open, these masses were found to be bored by *Lithodomus dactylus*, but the molluscs were dead, apparently shut in by the rapid growth of the Coral.

Locality.—Barra Grande, Brazil, 30 fathoms.

Genus 25. *Cyphastræa*, Milne-Edwards and Haime.

Cyphastræa et *Solenastræa*, Milne-Edwards and Haime, Cor., ii. pp. 484, 495.

Following Klunzinger,[2] I have united the genera *Solenastræa* and *Cyphastræa* under the latter name, which was first defined by Milne-Edwards and Haime, and should therefore be retained. The extreme forms of the genus present very striking differences, and would certainly warrant generic separation but for the clearly intermediate nature of many other species.

Four species were obtained.

1. *Cyphastræa pleiades* (Ellis and Solander).

Madrepora pleiades, Ellis and Solander, Zoophytes, p. 169, pl. liii. figs. 7, 8.
Astræa pleiades, Dana, Zoophytes, p. 213, pl. x. fig. 5.

A dead and worn specimen occurs in the collection. The size of the cells is rather variable, being often only 2 mm., especially towards the basal part of the colony. The

[1] Dana, Coral and Coral Islands, p. 336.
[2] Cor. roth. Meer., iii. p. 50.

habit of growth is incrusting, and it spreads over and ultimately surrounds the object on which it grows.

Locality.—Mactan Island, Philippines.

2. *Cyphastræa microphthalma* (Lamarck).

Astræa microphthalma, Lamarck, Hist. Anim. sans Vert., ii. p. 273, 1816.
Cyphastræa microphthalma, Milne-Edwards and Haime, Cor., ii. p. 485.

A small gibbous specimen, the growth of which has been much disturbed by parasites, presents some interesting varietal points. The columella is scarcely seen from without, and is but slightly developed; the cups are generally quite close, especially in the depressed parts, evenly rimmed with prominent and wide septa, which are much thinner at the wall than is shown by Milne-Edwards and Haime.[1]

Locality.—Mactan Island, Philippines.

3. *Cyphastræa aspera*, n. sp. (Pl. IV. figs. 3–3*a*).

Corallum incrusting, forming a thin layer. Epitheca very distinct at the margin. Calicles circular, nearly immersed, about 1·5 mm. wide, very deep, separated by interspaces equal to their own diameter; costæ scarcely distinct, finely and obsoletely spinulose; wall nearly even with the surface. Septa extremely exsert, easily broken away, slightly thickened and very narrow, scarcely projecting into the fossa, forming a circle of high, rather delicate, narrow, cultriform plates at the margin of the calicles which give to the corallum a rough bristling aspect: of three cycles, the last incomplete and very small; those of the first and second cycles indistinguishable in size from each other, but very unequal on opposite sides of the same calicle, granulated and subentire. Columella small or rudimentary.

A small specimen of this interesting species was obtained, consisting of a thin, living, rather uneven layer, which has spread over an equally thin, dead layer. It differs considerably in appearance from the ordinary species of *Cyphastræa*, but seems to be connected with them by the *Cyphastræa ocellina* (Dana). Its general appearance recalls the *Oculinæ*, as mentioned by Dana for the *Cyphastræa ocellina* and *Cyphastræa danæ* (=*Astræa microphthalma*, Dana).

Locality.—Api, New Hebrides.

4. *Cyphastræa brueggemanni*, n. sp. (Pl. IV. figs. 4–4*a*).

Corallum incrusting at base and surrounding other bodies, forming in this manner large, rounded, unevenly globose masses, which are attached by a very small base.

[1] *Ann. d. Sci. Nat.*, ser. 3, vol. x. pl. ix. fig. 5.

Calicles closely placed, separated by spaces equal to about half of their diameter or less except at the outer part of the colony where they are more distant; circular, deep, slightly prominent, rather large, being from about 2·5 to 3 mm. wide; costæ distinct only in the neighbourhood of the calicles, the outer border almost vertical, thickened and denticulate; the intercalicinal spaces finely and irregularly echinulate; walls thin; septa of three complete cycles, slightly thickened at the wall; the first and second cycles equal, exsert and subtruncated, finely denticulate, very granulated, broad, leaving a very narrow central space, at the bottom of which is the well-developed and trabeculate columella, chiefly formed by the perforated edges of the septa; septa of the third cycle, generally narrow and thin, and distinct only at the wall. Exotheca subvesicular, rather dense and compact.

This species is named after the late Dr. Brüggemann, who first recognised its specific distinctness, but did not describe it. Owing to the equal prominence of the primary and secondary septa, the calicles have a very even and regular appearance.

One specimen in the collection presents an interesting variety of growth, which seems to have been produced by injury due to exposure. Apparently the polyps over nearly the whole surface must have been killed, except on a small area, from which subsequent growth has proceeded, covering a considerable lateral portion of the old corallum with a thin layer, the edges of which are clearly distinguishable from the older growth.

Locality.—Mactan Island, Philippines.

Genus 26. *Leptastræa*, Milne-Edwards and Haime.

Leptastræa et *Baryastræa*, Milne-Edwards and Haime, Cor., ii. pp. 493, 512.

Following Klunzinger,[1] I have united the *Leptastræa* and *Baryastræa* of Milne-Edwards and Haime under the former name. These genera do not seem to be separated from each other by any character of classificatory value.

Four species are in the collection, obtained at Tahiti. Three of them do not seem to differ in any marked character from the Red Sea forms.

1. *Leptastræa solida* (Milne-Edwards and Haime).

Baryastræa solida, Milne-Edwards and Haime, Cor., ii. p. 512, pl. D. 8, fig. 2.

The larger calicles in this species often attain a diameter of 5 mm., with the fourth cycle imperfectly developed.

A small specimen occurs in the collection.

Locality.—Tahiti.

[1] Cor. roth. Meer., iii. p. 43.

2. *Leptastræa ehrenbergana*, Milne-Edwards and Haime.

Leptastræa ehrenbergana, Milne-Edwards and Haime, Cor., ii. p. 494, pl. D. 7, fig. 4.

A specimen in the collection differs from the Red Sea form in having the cups deeper, being generally as much as 3 mm. The small septa are sometimes united with one another at the centre, as in *Leptastræa stellulata*.

This species, which has been redescribed and figured by Klunzinger,[1] seems to be scarcely distinct from *Leptastræa purpurea* (Dana).

Locality.—Tahiti.

3. *Leptastræa roissyana*, Milne-Edwards and Haime.

Leptastræa roissyana, Milne-Edwards and Haime, Ann. d. Sci. Nat., ser. 3, vol. x. pl. ix. fig. 6; Cor., ii. p. 494.

The form of the corallum is very variable owing to the shape of the body which it incrusts; generally, however, it becomes thick, massive, and convex at the central portion.

Two small, unevenly convex specimens are in the collection.

Locality.—Tahiti.

4. *Leptastræa transversa*, Klunzinger.

Leptastræa transversa, Klunzinger, Cor. roth. Meer., iii. p. 46, pl. vi. fig. 2.

A specimen in the collection differs from the ordinary plate-like form of the species in having an irregular nodular incrusting corallum, which assumes the shape of the body it has covered. The thin grooved walls and the very thin septa give a delicate appearance to the species. The cups are often nearly 3 mm. deep, and the columella but slightly developed.

Locality.—Tahiti.

Genus 27. *Merulina*, Ehrenberg.

Merulina, Ehrenberg, Cor. roth. Meer., p. 104.
„ Milne-Edwards and Haime, Cor., ii. p. 628.
„ Duncan, Rev. Madrep., p. 128.

Two species of the genus were obtained.

1. *Merulina crispa*, Dana.

Merulina crispa, Dana, Zoophytes, p. 274.

A small specimen of this small species was obtained. The septa are not evenly lax, but are generally closely placed, except at the extreme apical parts. The *Merulina*

[1] Cor. roth Meer., iii. p. 46, pl. vi. fig. 3.

ramosa, Milne-Edwards and Haime, seems to be very close to this species, and appears to correspond with the upright, narrow foliated form which results from the flexure of the frond, and the coalescence and upgrowth of the opposed surfaces.

Locality.—Banda.

2. *Merulina prolifera*, n. sp. (Pl. V. figs. 1–1*a*).

Corallum small, ramose, with the branches very slender, much divided, closely crowded, and very coalescent; forming dense, intricate clumps, covered above with dense clusters of small branchlets, which are angular, irregular, and often much flattened, alate, palmated and divaricate; the branches are from 3 to 5 mm. thick, widening at the point of origin of the branchlets. The ridges are very small, narrow and elongated on the branches, and almost obsolete; more distinct on the branchlets where they are much raised and very acute. The calicinal centres are very indistinct; the septa are narrow, closely placed and short on the branches, less crowded, long and broad on the branchlets, especially on the extreme apical parts, where they are very prominent.

This species is close to the *Merulina laxa*, Dana, but differs in many characters. The specimen forms a clump about 11 cm. in height and about the same in diameter.

Locality.—Ternate.

Family Cyathophyllidæ.

Genus *Moseleya*, Quelch.

Moseleya, Quelch, Ann. and Mag. Nat. Hist., vol. xiii., 1884, p. 292.

Corallum compound, flattened, or slightly and broadly convex. Young calicles developing by calicinal marginal budding around a very large median calicle, which has very numerous septal orders, the calicles becoming polygonal and deep at the centre. Epitheca very slight, wall very thin and almost rudimentary, but developed so as to give a distinct, simple line of separation to the calicles on the surface, often interrupted, seen in section in a very rudimentary state separating the calicinal centres. Costæ very distinct, thin, and finely denticulate. Septa often confluent and continuous from centre to centre in the line of union between adjoining calicles, very thin and close, finely toothed above, and having the teeth subequal or slightly larger near the centre. Endothecal dissepiments vesicular, very abundantly developed, leaving but a very small portion of the septa free exteriorly, except at the centre of the cup, which is thus much depressed; they are often arranged in concentric circles, which are very distinct at the central portion, where by fusion and consequent thickening they form well-marked sub-infundibuliform tabulæ. A false columella is present, seen exteriorly to be formed

by the trabeculate and vermiform structure of the innermost upper part of the septa, absent in transverse section. In the tabulæ the septa are rather distinct, and are seen to meet quite at a point at the centre.

It is thus seen that this genus agrees with *Cyathophyllum* in every essential respect except that the septa are not alternately equal. In *Moseleya* the septa are of variable length, terminating either at the centre or close to the outer border, or at almost any intermediate point, though not infrequently they are alternately subequal, a condition more clearly seen in transverse section. A decided approach, however, is found in many species of *Cyathophyllum*, where in transverse section three or even four different lengths of septa are frequently present (*e.g.*, *Cyathophyllum stutchburyi*, *Cyathophyllum rugosum*, *Cyathophyllum regium*).

With *Strombodes*, the agreement in the lengths of the different orders of septa is very close, but the wall is much more developed in *Moseleya*, while the septo-costæ do not form the vesicular, trellised appearance so common in *Strombodes*.

Moseleya latistellata, Quelch (Plate XII. figs. 1–7).

Moseleya latistellata, Quelch, Ann. and Mag. Nat. Hist., vol. xiii., 1884, p. 293.

Calicles very large, the parent median calicle attaining a width of about 6 cm., but becoming smaller by the development of new calicles around it, and attached by a very broad base to the surface on which it grew. Epitheca and wall very thin, the wall often rudimentary between the confluent septa of adjacent calicles. Costæ distinct and finely denticulate above, continuing as well-marked lines to the very base. Septal system containing orders of seven cycles, but the last two cycles are incompletely developed, there being about two hundred septa in the largest calicle; the septa are thin, finely cut into subequal sharp teeth (nearly 1 mm. in length), laterally granulated and thickened, chiefly so in the direction of the teeth, free above only for a short portion owing to the great development of vesicular endotheca, but at the centre exteriorly the endotheca is much less developed, and consequently the calicles become much deeper and the septa more prominent. The septa of the first two or three orders are about equal, and run nearly or quite to the centre; those of the higher orders are somewhat smaller and shorter, though many run nearly to the centre; the highest orders are very small and are distinct only at the edge of the calicles. With the exception of these last, the septa are regularly placed and equally raised, giving a very even appearance to the calicles, especially to the older ones. Pali and true columella absent; but the finely trabeculate inner and upper edges of the septa give the appearance of a small columella. Endotheca abundant, vesiculate; vesicles large.

Of this species a single specimen was obtained. It consists of a very large central parent calicle, around which have developed by marginal budding several smaller calicles,

which in their turn have also given rise to smaller ones. The parent calicle is circular, and attains a very large size, apparently being more than 6 cm. in diameter, before the development of buds takes place around it; and by the encroaching of the smaller calicles upon its surface, it becomes at the same time both polygonal in shape and smaller in size. A very curious feature is that the parent calicle of the colony has grown out of, and immediately above, another large similar calicle which was simple and which produced no marginal buds to form a colony. It seems to be a simple case of rejuvenescence, although the border of the lower calicle projects for some little distance on one side beyond and outside of the base of the upper one. It is easily understood that, if the same conditions had prevailed during the growth of the second upper calicle, and throughout successive generations, as had prevailed during the life of the dead lower one, instead of forming a convex colonial mass, the whole colony would have assumed the appearance of an elongated cylinder made up of successive superposed calicles, as in the simple species of *Cyathophyllum*.

A very young stage of the species is seen on the projecting portion of the dead lower calicle, where a small calicle has budded off. In this small cup three large and thick septa are distinctly seen, arranged like three arms of a Maltese cross, while the fourth arm is but slightly, though distinctly, larger than the septa around it. Though thus pointing to a distinct tetrameral arrangement of the septa, it seems to me, however, to be more likely a case of accidental growth, since no clear evidence of tetrameral arrangement can be found in the other calicles of the colony.

The tabulæ of this form are peculiar, and present rather closely the shape found in *Strombodes*. Looked at from below, they are seen to be sub-infundibuliform, the septa being prolonged to meet at the centre. At this point, and for some distance around it, the obliquely placed dissepiments coalesce to form a nearly solid, dense plate in which the septa can be distinguished.

Though differing from the most completely formed tabulæ, as seen in *Amplexus*, by this distinctness of the septa, the tabulæ of *Moseleya latistellata* present all the fundamental features of those characteristic of many of the Cyathophyllidæ, in several of which also the septa are distinguishable. The tabulæ are placed regularly one above the other, with vesicular endotheca between them, as can easily be shown by removing the basal pointed part of the lower one, when the interior one is laid bare. They apparently correspond with the basal part of the new calicles, which are formed, probably, by rejuvenescence above the previously existing one; and in transverse section are seen as concentric circles of more or less variable thickness and regularity.

A transverse section, across the parent calicle, has been made of the single specimen obtained; but, owing to the small size and the thinness of the remaining parts, a vertical section would have been of no practical use, and was not attempted. The shape and nature of the tabulæ and their relation to each other, however, can be easily demonstrated by the views of the basal part of the corallum, where

the dissepiments have been removed to lay bare the tabulæ, and where one tabula has been partly removed to show the one above it.

Locality.—Wednesday Island, Torres Straits, 8 fathoms.

Section MADREPORARIA FUNGIDA.

Family PLESIOFUNGIDÆ.

Genus 1. *Siderastræa*, Blainville.

Siderastrea (pars), Blainville, Dict. d. Sci. Nat., lx. p. 335.
Astræa, Milne-Edwards and Haime, Cor., ii. p. 505.
Siderastræa, Duncan, Rev. Madrep., p. 134.

Siderastræa galaxea (Ellis and Solander).

Madrepora galaxea, Ellis and Solander, Zoophytes, p. 168, pl. xlvii. fig. 7.
Astræa radians, Milne-Edwards and Haime, Cor., ii. p. 506.

Following Pourtalès[1] I have adopted the specific name of Ellis and Solander instead of that of Pallas. Only a single specimen was obtained, and it forms an almost spherical, free mass, about 8 cm. in diameter. The species is very variable in the thickness and prominence of the primary and secondary septa. Excellent figures are given in the plates of the Report on the Florida Reefs.[2]

Locality.—Bermuda.

Genus 2. *Tichoseris*, Quelch.

Tichoseris, Quelch, Ann. and Mag. Nat. Hist., vol. xiii., 1884, p. 295.

Corallum compound, massive, columnar or lobate, with neither transverse calicinal ridges nor longitudinal crests, astræiform. Calicles with distinct, elevated walls, which are solid throughout, thin at their upper edges, but thick at the basal part of the calicles; calicinal centres arranged sometimes singly within their own walls, but generally united in more or less irregularly sinuous groups of two or more centres, incompletely separated from one another, and surrounded by the common wall of the calicle from which they are developed. New calicles arise either by direct division of a single calicle forming two separate ones with distinctly raised walls, or by the upgrowth of synapticulæ at one or more parts of the calicle to form new walls, the resulting centres forming more or less mæandrine series, until the final development of their own wall isolates them. Septa solid, entire, not confluent, those of adjoining calicles quite separated by the elevated wall, but often directly opposite each other. Columella absent or forming deep down a small styliform projection at the point of coalescence of the

[1] *Illust. Cat. Mus. Comp. Zoöl.*, No. iv. p. 81. [2] *Mem. Mus. Comp. Zoöl.*, U.S.A., vol. vii. No. i.

inner margin of the septa. Synapticulæ distant, very unequally and irregularly developed, being generally rather thick, interseptal outgrowths of the upper part of the wall. Endotheca well developed, deep down, easily seen in a vertical section. A transverse section shows the calicles with distinct centres generally arranged in sinuous valleys, which are bounded by thick and solid walls.

This genus is close to *Pavonia*, in some species of which an approach is made at the apical parts of the corallum to the arrangement of the calicles in isolated and subsinuous groups with elevated and solid walls. In *Tichoseris*, however, the walls are elevated at all parts of the corallum, the interseptal chambers are extremely deep, the dissepiments being inconspicuous from above, and the sinuous and mæandrine arrangement of the calicles well marked.

Tichoseris obtusata, Quelch (Pl. V. figs. 3–3*c*).

Tichoseris obtusata, Quelch, Ann. and Mag. Nat. Hist., vol. xiii., 1884, p. 296.

Corallum consisting of blunt, elongated or rounded, lobate masses, of very dense structure throughout. Calicles small; often separate, subcircular or elongated and polygonal, from about 3 to 5 mm. in diameter, deep, but often appearing almost filled up and shallow, owing to the closely packed septa; more generally from two to six or more calicles are grouped together, with their walls *incompletely* developed, so that they give the appearance of many centres surrounded by one raised wall, which is of very irregular shape and size, being long, sinuous, mæandrine, and narrow, or rounded and wide, often from 5 to 14 mm. in diameter. Wall very solid throughout, thin-edged above, but thick below. Septa not exsert, very numerous, in the separate calicles there are as many as five cycles, but the fifth is very incomplete; those of the first two cycles are subequal those of the fourth and fifth very small; but all are entire, very thin, extremely granulated or finely echinulated on their sides, with their inner edges nearly vertical. Columella very rudimentary. Dissepiments very thin, and rather widely separated.

Two small specimens of this species were obtained.

Locality.—Reefs, Fiji.

Genus 3. *Pavonia*, Lamarck.

Pavona (pars), Lamarck, Syst. Anim. sans Vert., p. 382, 1801.
Pavonia (pars), Lamarck, Hist. Anim. sans Vert., ii. p. 238, 1816.
Lophoseris, Milne-Edwards and Haime, Cor., iii. p. 65.
„ Duncan, Rev. Madrep., p. 157.

As Verrill[1] points out, Lamarck's application of the name *Pavonia* claims priority over Hübner's use of the term for a genus of Lepidoptera, and it must therefore be retained. The dissepiments, which were not noticed by Milne-Edwards and Haime, have been described by Verrill, as already stated.

Five species were obtained.

[1] *Trans. Connect. Acad.*, vol. i. p. 543, 1868.

1. *Pavonia divaricata*, Lamarck.

Pavonia divaricata, Lamarck, Hist. Anim. sans Vert., ii. p. 240, 1816.
Dana, Zoophytes, p. 327, pl. xxii. fig. 6.

Three fragments of this species were obtained. *Pavonia seriata* and *Pavonia minor*, Brüggemann, are so close both to one another and to this species that it seems likely they will have to be united with it.

Locality.—Tongatabu.

2. *Pavonia crassa*, Dana.

Pavonia crassa, Dana, Zoophytes, p. 331, pl. xxiii. fig. 2.

Two small fragments of this species were obtained, which are about 1 cm. thick at a distance of 2·5 cm. from the margin. The septa are scarcely crowded and the surface consequently has a rather open appearance. The special septa, which are continuous from centre to centre in a transverse direction, are thickened and very conspicuous.

Locality.—Tongatabu.

3. *Pavonia decussata*, Dana.

Pavonia decussata, Dana, Zoophytes, p. 329, pl. xxii. fig. 4.

A single specimen referable to this species was obtained. The greater portion of it consists of a dead corallum, which has been overgrown and almost entirely covered by fresh growth, so that the specimen becomes very like a small one of *Pavonia crassa*. The larger lobes, which have been formed chiefly by this incrustation over previously formed plates, are on this account much thicker than those in the specimens described by Dana. Numerous small plates spring out irregularly over the surface.

It is very close to *Pavonia* (*Madrepora*) *cristata*, Ellis and Solander.

Locality.—Api, New Hebrides.

4. *Pavonia formosa*, Dana.

Pavonia formosa, Dana, Zoophytes, p. 525, pl. xxiv. fig. 2.

Two specimens of this species were obtained. One is a large, broad, and variously lobed frond, which originally was part of a very finely grown specimen, typical of the species; the other consists in great part of a dead corallum, the summits of which have been covered by fresh growth, which takes the form of very divided, rather thin lobes and crispate fronds. The species is very close to *Pavonia prætorta*, and the latter specimen seems to point to their identity.

Locality.—Tahiti.

5. *Pavonia prætorta*, Dana.

Pavonia prætorta, Dana, Zoophytes, p. 325, pl. xxii. fig. 5.

Some fine specimens and small fragments of this species were obtained. It is much more delicate than *Pavonia cactus*. The septa of the apical calicles are very unequal both in this species and in *Pavonia formosa*, which greatly resembles it; in the more basal calicles the septa are subequal.

Locality.—Tahiti.

Genus 4. *Agaricia*, Lamarck.

Agaricia (pars), Lamarck, Syst. Anim. sans Vert., p. 375, 1801.
Undaria et Mycedium (pars), Oken, Lehrb. der Naturg., Zool., i., 1815.
Agaricia et Mycedium (pars), Milne-Edwards and Haime, Cor., iii. pp. 72, 80.
Agaricia et Mycedium, Duncan, Rev. Madrep., pp. 158, 161.

The characters on which the genus *Mycedium* has been maintained to be separate from *Agaricia* seem to me altogether insufficient for generic distinction, and, bearing in mind the great variation which takes place in the concentrically seriate arrangement and circumscription of the calicles in the species which have been placed under these genera, I believe it will be impossible to find any fairly constant character by which to separate them. A careful comparison of a series of specimens of *Agaricia agaricites*, *Agaricia frondosa*, *Agaricia undata*, *Agaricia lamarcki*, *Agaricia* (*Mycedium*) *fragilis*, *Agaricia* (*Mycedium*) *elephantotus*,[1] will show all stages between the concentrically seriate arrangement of the scarcely circumscribed calicles and the more or less scattered arrangement with well circumscribed cups. This variability in the arrangement of the calicles is well shown even by individual specimens of the same species, *Agaricia* (*Mycedium*) *fragilis* furnishing a typical case, as pointed out by Pourtalès.[2] So completely transitional is this species between the more extreme forms of the genus, that Dana himself, while he places it in the subgenus *Mycedia*, states,[3] in his description of the species, that it "has much of the habit of *Agaricia undata*, and might with equal propriety be placed among the *Undariæ*" (*Agaricia* proper).

The *Mycedium* of Milne-Edwards and Haime, besides *Agaricia elephantotus*, contained three other species, two of which are forms of the genus *Phyllastræa*, *Phyllastræa tubifex*, and *Phyllastræa oweni*; and the other apparently an old form of a species of *Leptoseris*, *Leptoseris elegans*. The genus *Phyllastræa* is well distinguished, both by its spongy columella and by its distinctly scattered calicles, the well-developed, raised wall of which is very prominent on one side and is not due to flexure of the lamina nor to the fusion of synapticular structures. The genus *Leptoseris* was founded on a young

[1] This specific term, which was used by Pallas (Elench. Zooph., p. 168), and which has been retained in the same form by later writers, would seem to have been a misprint for "elephantopus."

[2] *Illus. Cat. Mus. Comp. Zoöl.*, Cambridge, U.S.A., No. iv.

[3] Zoophytes, U.S. Expl. Exped., p. 341.

specimen in which very few radial calicles had as yet developed around the central cup.[1] From young forms of the genus *Agaricia*, notably from those of the species *Agaricia fragilis*, Dana, it seems to me impossible satisfactorily to distinguish the genus *Leptoseris*, and most likely the two genera will have to be united.

Owing to the presence of dissepiments in this genus, it must be placed under the Plesiofungidæ, although the extremely close relationship between it and the Cycloseridæ seems to render such a classification extremely artificial. More research is needed on the presence of dissepiments in allied genera, and on the value which is to be placed on these structures for the classification of the Fungida.

Three species were obtained.

1. *Agaricia fragilis*, Dana.

Agaricia (*Mycedia*) *fragilis*, Dana, Zoophytes, p. 341.

A large and interesting series of specimens was obtained. They are of all sizes, from the very young stages up to those with a diameter of 25 cm., and show very clearly the great variability in the characters of the species. This variability was pointed out by Pourtalès in his Report on the Deep-Sea Corals,[2] where he remarks :—"Several of the specimens obtained by me in the same dredgeful, if seen separately from different localities, would unhesitatingly be pronounced different species." As stated by him, the species is distinct from *Agaricia undata*, but, as remarked by Milne-Edwards and Haime, it is very closely allied to it. Excellent figures are given in the plates of the Report on the Florida Reefs, in which all the developmental stages are figured. Pourtalès obtained it in the deep-sea dredgings, and remarks that it is not uncommon at less depths, although not common on reefs; but Professor Moseley remarks on its occurrence in very shallow-water on the Bermuda reefs, and states that it "occurs growing in colonies, in great abundance, in water from a foot to a fathom in depth, inside small caverns."[3]

Two specimens, obtained from St. Thomas, differ somewhat from the greater number of Bermuda ones in being thicker at the central parts, in having the calicles less closely placed, and in being more contorted and incrusting. They would seem to fall into the *Mycedium danæ*, Duchassaing and Michelotti, but this can only be regarded as a thick variety of the *Agaricia fragilis*, since the thickness, in different specimens, is very variable.

Localities.—Bermuda; St. Thomas.

[1] Voy. au pôle sud de Dumont D'Urville, Zool., vol. v. pl. xxix. fig. 1.
[2] *Illust. Cat. Mus. Comp. Zoöl.*, No. iv. p. 48.
[3] Notes by a Naturalist on the Challenger, p. 27.

2. *Agaricia frondosa*, Duchassaing.

Agaricia frondosa, Duchassaing, Revue des Zooph. et Spong. des Antilles.
" " Duchassaing and Michelotti, Suppl. Mém. Cor. des Antilles, pl. x. figs. 5, 6.

A single specimen of this species was obtained. It agrees very closely with the figures given by the authors, except that the magnified calicles are drawn with too many septa, there being seldom more than thirty. It bears a close resemblance to the young specimens of *Agaricia agaricites*, but instead of the evenly arranged, seriate calicles characteristic of that species, the calicles are closely placed but irregularly arranged, raised or depressed, and the synapticulate walls do not form thick, solid, sharp-edged crests.

Locality.—St. Thomas.

3. *Agaricia regularis*, n. sp. (Pl. V. figs. 7–7*b*).

Corallum explanate, more or less incrusting, with a wide, free edge; extremely solid, from 5 to 7 mm. thick quite close to the margin, becoming quite thick at the central part; the margin very sharp-edged. The under surface irregularly and faintly undulate, with distinct, sharp, more or less concentric edges as though produced by separate lines of growth, faintly and finely striate with very closely crowded, minute, regular, radiate costæ. Upper surface somewhat unevenly raised and depressed, with calicles sometimes arranged in irregular, more or less distinct series, but never elevated at the lower border so as to become oblique. Calicles generally irregularly placed, subcircular or subpolygonal, small, from 1·5 to 3 mm. in diameter, rather shallow, close, even at the margin, separated by rounded interstices which are quite narrow or rather broad (from 1 to 2·5 mm. wide) over which the septa are continuous from centre to centre. Three cycles complete, a fourth often present and incomplete. The septa are small, granulated, very thin and even, appearing like striations on the surface. Columella small, tuberculate. Synapticulæ small, thin, and very distinct in the marginal calicles where they are regularly placed and parallel; but becoming closer and thicker on the more central parts, and eventually fusing to form a solid wall. Endotheca very slightly developed, rudimentary.

The species is represented by a fragment about 9 cm. long.

The form differs from the other known species of *Agaricia* in the much more scattered arrangement of the calicles; but this affords no grounds for generic separation since the arrangement of the calicles is extremely variable in the genus. It seems to have a close resemblance to the *Agaricia planulata*, though differing in numerous characters from that species.

A striking feature of the species is the nature of the synapticulæ, which are extremely

distinct on the marginal parts, close, thin, and regularly arranged in parallel lines; but which, as the growth proceeds, become gradually thicker and closer, and eventually fuse to form a broad, rounded, solid wall. The costal area is also peculiar owing to the sub-concentric sharp edges which mark it, and which would appear to have been produced by separate periods of growth.

Through this form the genus *Agaricia* is closely related to *Siderastræa*.

Locality.—Levuka.

Family Cycloseridæ.

Genus 1. *Cycloseris*, Milne-Edwards and Haime.

Cycloseris et *Diaseris*, Milne-Edwards and Haime, Cor., iii. pp. 49, 54.
„ „ Duncan, Rev. Madrep., pp. 149, 150.

I have placed *Diaseris* as a synonym of *Cycloseris*, since I am convinced that the curious forms which have been referred to that genus are nothing more than broken pieces of specimens of *Cycloseris*, which in this broken condition have continued living, and have, in part or wholly, repaired the injury.

The early view which was held by Milne-Edwards and Haime as to the constitution and formation of these curious forms, namely, that in the young state the specimens have the form of separate pieces or lobes, and that these unite irregularly during growth, has long ago been proved by Semper to be untenable; and indeed one is inclined to wonder that such an opinion, with all that it implies for the formation of those structures, should have been advanced by such writers as Milne-Edwards and Haime.

Tenison-Woods has already noticed the extremely close relationship between the two genera, though the formation of the specimens of the so-called *Diaseris* did not strike his attention.

Specimens in the Challenger collection and in the collection of the British Museum show well the different shapes and degrees of growth of the forms; and in the Challenger collection occur two perfect specimens of *Cycloseris* (*Diaseris*) *freycineti*.

Owing to the thinness and delicacy of the small and large specimens of the greater number of the recent species of *Cycloseris*, and especially owing to the thinness of the wall, such specimens would be very easily broken, whether by the action of various animals or by the play of winds and waves; a liability which is much increased by the fact that these delicate corals are not attached—at any rate not except, perhaps, in their very young stages. And this seems to me sufficient to account for the fact that so large a proportion of distorted and mended or broken specimens are found in comparison with the perfect specimens.

Such reparation of injury is very common among the Fungidæ; and injury to the

corallum is very common among these forms owing to the fact that the members are unattached except in their very young stages—*Podabacia* excepted. Such injury and consequent reparation are frequently met with in *Fungia*, *Halomitra*, *Herpetolitha*, and *Lithactinia*, and occasionally in *Podabacia* and *Cryptabacia*; though the thickness of the corallum in the larger number of cases would prevent the fracture giving rise to many pieces, and hence the growth resulting from injury in these forms would seldom, if ever, present the complicated arrangement found in the repaired forms of *Cycloseris*.

According to the size and shape of the fragment, would be the shape and relative size of the different parts of a repaired form. If the specimen broken be quite small, its adult repaired form, though showing the lines of fracture or interrupted growth, will take on most closely the circular shape of the perfect specimen, and such forms as these are extremely common in the *Cycloseris distorta* and *Cycloseris freycineti*. When the fracture occurs in specimens that are larger, but yet not adult, the adult repaired specimen presents marked inequality between the older and the later growth on the two sides; and this condition is again extremely common among specimens of the above species. Complication of parts may arise in both of these cases, by additional or subsequent fracture in the repaired specimen. A very common condition met with is that in which smaller or larger pieces are found, in which reparation has not yet taken place or has just begun, the new growth in the later case being found almost invariably to be in a direction at right angles to the line of fracture of the specimen along the whole course of this line. If the specimens broken be large this condition persists in the repaired form; if the specimens be small it becomes much altered in the course of growth, the septa becoming inclined at a gradually lessening angle along the original lines of fracture.

In a large series of specimens of *Cycloseris distorta* and *Cycloseris freycineti*, it is easy to recognise the various steps as above described, which force one to the only explanation that is possible of their origin and development.

Six species of the genus were obtained.

1. *Cycloseris distorta* (Michelin).

Fungia distorta, Michelin, Mag. de Zool., v. (Zooph.), pl. v., 1843.
Diaseris distorta, Milne-Edwards and Haime, Cor., iii. p. 55, pl. D. 12, fig. 4.
„ „ Semper, Zeitschr. f. wiss. Zool., Leipzig, xxii. pl. xxi. fig. 2.

Two pieces of separate specimens were obtained, one of which is about 5 cm. in diameter.

Locality.—Santa Cruz Major Island, off Samboangan, Philippines, 10 fathoms.

2. *Cycloseris tenuis* (Dana).

Fungia tenuis, Dana, Zoophytes, p. 290, pl. xviii. fig. 1.
Cycloseris tenuis, Moseley, Chall. Rep. Deep-Sea Corals, p. 190, pl. x. fig. 6.

It is with extreme doubt that I have retained this species. I am of opinion that it is but the circular and normal form of *Cycloseris* (*Diaseris*) *distorta*, which name claims priority and should therefore be substituted for it.

A large specimen was obtained, the longer diameter of which is about 6 cm. The species in its earliest stages is hexahedral, then dodecahedral, owing to the enlargement of the secondary septa; it is ultimately subcircular or slightly elliptical.

Cycloseris hexagonalis, Milne-Edwards and Haime, appears to be identical with this species.

Locality.—Samboangan, Philippines.

3. *Cycloseris cyclolites* (Lamarck).

Fungia cyclolites, Lamarck, Hist. Anim. sans Vert., ii. p. 236, 1816.
Cycloseris cyclolites, Milne-Edwards and Haime, Cor., iii. p. 50, pl. D. 12, fig. 3.

A large, dead, and worn specimen was obtained, which does not appear to differ at all from this species. Though the dentation of the septa is destroyed, yet the characters of the lower surface are sufficient to fix the generic position of the specimen. It is by far the largest form of this species which has hitherto been obtained, being 10 cm. in the long axis and nearly 9 cm. in the short axis; it is about 4 cm. high.

A small specimen of this species also was dredged off Santa Cruz Major Island, Samboangan, 10 fathoms.

Locality.—Samboangan, Philippines.

4. *Cycloseris freycineti* (Milne-Edwards and Haime).

Diaseris freycineti, Milne-Edwards and Haime, Cor., iii. p. 55.
„ „ Semper, Zeitschr. f. wiss. Zool., Leipzig, xxii. pl. xxi. fig. 1.

Two circular specimens of this species were collected, which show no traces either of irregular growth or of injury. One is about 3 cm. in diameter and nearly 1 cm. high, evenly convex above and concave below; the other is smaller and nearly flat. The corallum is rather thin, with the edges rounded, being from about 4 to 5 mm. thick at the centre, and about 2 mm. thick at the margin. The axial cavity is very pronounced, rather deep and elongated; the four lateral, primary septa are very distinctly prominent at this part, and the columella is very developed, papillose and very even. The septa are of seven complete cycles, very low, evenly and closely placed, thick and nearly subequal in the larger cycles, very thin in the last cycle, evenly and vertically perforated and trellised, with abundant and very thick granules over the whole surface, the upper

border being roughly jagged. Owing to the close and even arrangement of the septa the perforations are quite inconspicuous in a surface view of the corallum.

Locality.—Santa Cruz Major Island, off Samboangan, Philippines, 10 fathoms.

5. *Cycloseris sinensis*, Milne-Edwards and Haime.

Cycloseris sinensis, Milne-Edwards and Haime, Cor., iii. p. 51.

Four specimens, varying from 2 to 4 cm. in diameter, were obtained. The species seems well characterised by the extremely thin and delicate corallum, much more thin and delicate than in any other species of the genus, nearly acute at the margin, with extremely fine costal striations and very thin, fragile, close, numerous, fenestrated septa. The columella is slightly developed and is very finely papillose.

The form described by the Rev. J. E. Tenison-Woods as occurring in Australia, and referred by him to this species, seems to be distinct from it, and appears to be more closely allied both to *Cycloseris discus* and *Cycloseris freycineti*.

Locality.—Santa Cruz Major Island, off Samboangan, Philippines, 10 fathoms.

6. *Cycloseris discus*, n. sp. (Pl. VI. figs. 3–3*a*).

Corallum subcircular and thick, flat below, and nearly flat above, with the margin rounded and nearly as thick as the central part. Costæ very fine and finely denticulate, scarcely distinct except at the marginal parts, and appearing like striations on the surface. Septa closely and evenly placed, not elevated, giving a very neat appearance to the corallum, extremely and thickly granulated and spinulous, with a jagged border, of six complete cycles, with a seventh more or less incomplete, and occasionally with rudiments of an eighth cycle; those of the first four or five cycles not fenestrated, but thick and equal, and of varying length according to the cycle to which they belong, swollen close to their point of origin, at which point they are rather thin and acute; those of the last two cycles extremely thin, and vertically fenestrated, with a divided edge. Axial cavity very deep, oblong and narrow, definitely outlined, owing to the inner edges of the septa being nearly vertical. Columella more or less well developed, papillose and granulated.

Two specimens of this species were obtained; they form circular, thick and flattened disk-shaped coralla, which are from 2 to 2·5 cm. in diameter, and from about 7 to 8 mm. thick at centre, and from 5 to 6 mm. thick at the margin. The species seems to be close to the fossil species *Cycloseris semiglobosa* (Michelin), the figure of which, given by Michelin, is useless for purposes of identification. The description of the fossil form, however, differs in many characters from the present species.

Locality.—Santa Cruz Major Island, off Samboangan, Philippines, 10 fathoms.

Genus 2. *Trochoseris*, Milne-Edwards and Haime.

Trochoseris, Milne-Edwards and Haime, Cor., iii. p. 57.
,, Duncan, Rev. Madrep, p. 147.

The recent forms of this genus are closely similar to the young specimens of the genus *Leptoseris*, at the stage in which there is only a single central calicle. The two genera would seem to be distinguished simply by the nature of the scanty columella, which in *Trochoseris* is papillose and trabeculate, and in *Leptoseris* is tuberculate.

Trochoseris stokesi, Milne-Edwards and Haime.

Haloseris crispa, Rousseau (*non* Ehrenberg), Voy. au pôle sud de Dumont d'Urville, Zool., vol. v. pl. xxix. fig. 3.
Trochoseris stokesi, Milne-Edwards and Haime, Cor., iii. p. 58.

A portion of a corallum was obtained which, from its general structure, and from the absence of radial calicles, seems to be referable to this species. The piece does not show the calicular fossa, and apparently would form about one-third of the complete specimen. In the absence of the characters of the columella it may perhaps be doubted whether the fragment was not broken from a young specimen of a *Leptoseris* in which the radial calicles had not yet developed.

Locality.—Tahiti, from 30 to 70 fathoms.

Genus 3. *Pachyseris*, Milne-Edwards and Haime.

Pachyseris, Milne-Edwards and Haime, Cor., iii. p. 85.
,, Duncan, Rev. Madrep., p. 162.

Professor Verrill[1] considers that the name *Undaria* should be substituted for *Pachyseris;* but, as used by Oken, *Undaria* is a synonym of *Agaricia* and cannot therefore be adopted for another genus.

Pachyseris speciosa (Dana).

Agaricia speciosa, Dana, Zoophytes, p. 337, pl. xxi. fig. 7.

Two fragments were obtained which are referable to this species. The ridges are often irregular, rounded, and very slightly elevated. The columella is absent or quite rudimentary.[2]

The species is very close to *Pachyseris lævicollis*, but is quite different from *Pachyseris speciosa*, Milne-Edwards and Haime, which is evidently a new species, easily distinguished by its very acute and elevated ridges, which throughout the corallum are concave on their sides and very sharp at their margin, and by the abundant columella,

[1] Dana, Coral and Coral Islands, p. 336.
[2] See Dana's figure.

which forms a wide, continuous structure separating the ridges. This latter form has also a finer and more delicate structure than *Pachyseris speciosa*. It may be distinguished as *Pachyseris haimei*, n. sp.

Locality.—Tahiti.

Genus 4. *Cylloseris*, n. gen.

Corallum compound, consisting of more or less irregular, semi-incrusting, thin, explanate expansions, the under surface of which is faintly granulated and marked by very delicate costal striations. The upper surface very uneven, owing to the development of subconical, elevated, compact, perpendicular projections, which form neither longitudinal crests nor continuous transverse ridges, but which are often arranged in a subconcentric manner; these projections apparently formed by short, irregular, transverse flexures of the corallum at the margin, with consequent thickening and elongation by growth. The calicles are scattered and numerous, situated singly, both in the upper angle of the elevations, which consequently form large platforms below the calicles, and irregularly on the sides and extremities of the larger projections. The fossa extremely small. The parent calicle indistinguishable. The septo-costæ take the form of extremely delicate, very granulated, entire striations over the whole surface, continuous from centre to centre, giving a very even appearance to the projections. Columella tuberculate or sub-styliform.

The subconical or subcylindrical, elevated projections of the surface, with the almost inconspicuous cells and septa, give a peculiar appearance to this genus, and easily serve to separate it from all other Fungida. It has many points of alliance with the fossil genus *Hydnophorabacia*. This is clearly the undescribed genus referred to by Professor P. Martin Duncan in his Revision of the Families and Genera of Madreporaria, p. 164.

Cylloseris incrustans, n. sp. (Pl. VI. figs. 4–4*b*).

Corallum incrusting, often free for a large extent, much bent and contorted, and extremely thin at the margin. Costæ closely crowded, very faintly marked, almost obsolete; the under surface uneven, and closely and irregularly undulate. The projections of the upper surface are from 2 to 7 mm. high, irregular, subconical, often with an elongated base, and bent, and often continuous with one another; acute or rounded, rather close, sometimes crowded. Calicles, very small and shallow, the fossa being from about 0·5 mm. to 0·75 mm. wide; they are situated singly both at the base of each of the projections, in the upper angle, and on the larger and thicker projections. Septa of three or four cycles, often much elongated, very thin, appearing as fine striations, and scarcely distinguishable with the naked eye; continuous over the projections from centre to centre, but on the

apex of the projections very sinuous and often discontinuous. Columella well developed, rather compressed and tuberculate.

Two specimens of this species were obtained, the larger of which forms a thin, uneven, contorted plate, about 9 cm. long and 6 cm. wide, which has grown partly incrusting over a dead specimen of the same kind. At the margin it is less than 1 mm. thick, and between two of the projections the thickness is scarcely more than 2 or 3 mm. in the more central parts.

Locality.—Tahiti.

Genus 5. *Domoseris*, n. gen.

Corallum compound, consisting of broad, irregularly explanate plates, fixed at the centre, and often attached laterally by one or more irregular pedicels, which are especially developed in old specimens. The under surface imperforate, very uneven owing to irregular depressions, marked with distinct, but fine, costal striations. The upper surface very uneven, owing to numerous irregular projections, which correspond to the small depressions of the under surface; these projections are irregularly scattered and are arranged neither in longitudinal crests nor in transverse ridges. The calicles are numerous, scattered, developing singly both in the upper angle of the projections and on the extremities and sides of the larger ones; the parent calicle nearly or quite indistinguishable. Septo-costæ very uneven and distinct, continued nearly straight to the margin from adjoining calicles, but on the projections on the lower sides of the calicles, and throughout nearly the entire portion of the rest of the corallum, and more especially on the older parts, they become very irregularly thickened and swollen, shortly discontinuous, twisted, bent and contorted. Columella tuberculate, nearly inconspicuous.

This peculiar genus is well characterised by the nature of the septo-costæ, which present a decided approach to the structure found in the genus *Psammocora*. Owing to this peculiar structure, the projections are very different from those of the genus *Cylloseris*. The presence of the elevated projections, and the nature of the septo-costæ separate the genus from *Leptoseris*, which it somewhat resembles at the extreme marginal parts, where the projections are less marked and the septo-costæ more uniform.

Three species of the genus are in the collection.

1. *Domoseris porosa*, n. sp. (Pl. V. figs. 4–4*c*).

Corallum broad, explanate, thick, being about 15 mm. thick towards the centre, and from 5 to 8 mm. at about a distance of 3 cm. from the margin, slightly concave and irregularly shallow-vasiform above, chiefly composed of an abundant, trabeculate tissue derived from the perforated septa and the crowded synapticulæ; fixed below by many

supplementary bases of attachment. The depressions and prominences of the under surface small, irregular and numerous. Costal striations distinct, fine and subequal. Calicles very irregularly and unevenly placed, often crowded, frequently grouped into rather large, nodular masses over the surface, especially on the older parts, owing to the development of calicles on the projections. The fossa small and deep, from about 0·75 to 1·5 mm. in diameter. Septa apparently of three cycles, very close, small and unequal and unequally raised, granulated and perforated except at the extreme basal part. Septo-costæ almost straight at the marginal part of the corallum, and divided into more or less irregular, rather large, rounded teeth; but throughout the rest of the corallum, they are irregularly discontinuous, bent, sinuous and contorted, rather thin or irregularly swollen, thick and tuberculate, unequally toothed and prominent, more frequently so below the calicles, so that the surface has a rough and very uneven and irregular aspect. Columella small, deep down in the fossa, and not conspicuous. The synapticulæ are extremely well developed and abundant, subparallel, and separated by spaces about equal to their own diameter, clearly seen both in transverse and longitudinal section, and fused only throughout a thin basal lamina.

This species shows well the typical structure of the genus, which in its youngest stages is closely allied to the genera *Agaricia*, *Leptoseris* and *Trochoseris*, but which with growth becomes more clearly related in its adult forms to the genus *Psammocora*.

It is represented in the collection by a large portion (evidently broken off a large specimen), and by two small pieces.

Locality.—Tahiti.

2. *Domoseris solida*, n. sp. (Pl. V. figs. 5–5*a*).

Corallum broad, explanate, of a very dense and solid texture, thin, from about 8 to 10 mm. thick at the central portion, much thinner towards the margin, irregularly shallow-vasiform, with supplementary basal attachments. Under surface very finely striate, with very small and irregular depressions and prominences. Calicles very unevenly and irregularly placed, often crowded, and frequently grouped into small, nodular masses, due to the development of calicles on the projections of the surface. The projections are from 3 to 7 mm. in height and width, and are very uneven, more or less perpendicular to the surface and generally distinctly isolated. The fossa is rather deep and from about 0·75 to 1·5 mm. wide. The septa of two or three cycles, small, unequal, close, very granulated and solid. The septo-costæ in many parts are nearly straight especially towards the margin, alternately rather large and small, with an uneven border seldom divided into distinct teeth; towards the central parts, and more especially on the projections, they are more or less discontinuous, irregularly thickened, bent, sinuous, contorted and unevenly prominent, so as to give a rather rough aspect to the projections.

Columella tuberculate, distinct. Synapticulæ rarely conspicuous, fused throughout so as to give a close and dense texture to the corallum.

This species may be easily distinguished from *Domoseris porosa* by the rather finer striations of the under surface, by the more isolated projections of the upper surface, by the non-perforated septa, by the thinner, nearly entire, less swollen and less irregularly discontinuous septo-costæ, by its rather conspicuous columella, and by the fused state of the synapticulæ. It has many points of general resemblance to *Leptoseris* (*Mycedium*) *elegans* (Milne-Edwards and Haime), but differs from it in essential structure.

A single large specimen is in the collection.

Locality.—Tahiti.

3. *Domoseris regularis*, n. sp. (Pl. V. figs. 6–6*b*).

Corallum broad, explanate, irregularly bent, thin, from about 4 to 5 mm. thick at a distance of about 8 cm. from the margin, and very thin at the extreme marginal parts; with supplementary basal attachments. Under surface with well-pronounced depressions and prominences marked by fine costal striations. The calicles irregularly scattered, not crowded, and rarely or not at all grouped into nodular masses; the projections being low and rather small; the fossa small, about 1 mm. wide, rather deep. The septa of two or three cycles, unequal, close, very granulated, perforated; the septo-costæ nearly evenly raised, alternately very much thickened, with a rounded upper margin divided into rather unequal, broad, blunt teeth; often discontinuous, and, more especially below the more central calicles, very irregularly bent, sinuous and contorted. Columella small, inconspicuous. Synapticulæ small, irregularly developed, not abundant, nor fused throughout to form a continuous, solid lamina except quite at the base.

This species is easily distinguished from the *Domoseris solida* by its distinctly toothed and more unequal, perforated septa, by its non-fused synapticulæ, and by the less elevated and more distant projections of the upper surface. From the *Domoseris porosa* it is distinguished by the very thin corallum, by its much less uneven and scarcely rough surface, due to the more evenly raised and more equally thickened septo-costæ, which are much less discontinuous and contorted, by the much less perforated nature of the septa, and by the comparatively slight and irregular development of synapticulæ.

Only a fragment of a large specimen, and a very small specimen, were obtained. The small specimen is from about 2 to 3 cm. wide, irregularly shallow-vasiform, attached to and incrusting a portion of a shell. It contains about four distinct calicles which have the lower border scarcely at all raised, with the septo-costæ irregularly toothed and subentire. Its growth has been much interrupted by foreign matter, so that the parent calicle does not occupy a central position.

Locality.—Tahiti, 30 to 70 fathoms.

Genus 6. *Psammocora*, Dana.

Psammocora, Dana, Zoophytes, p. 344.
„ Milne-Edwards and Haime, Cor., iii. p. 219.
„ Duncan, Rev. Madrep., p. 192.

Recent investigation has shown that this genus must be placed under the Fungida and not under the Perforata, as in the system of Milne-Edwards and Haime.

Three species are in the collection.

1. *Psammocora exesa*, Dana.

Psammocora exesa, Dana, Zoophytes, p. 348, pl. xxvi. fig. 1.

A small specimen of this species occurs in the collection. It is a broken specimen, with short and thick, obtuse lobes; the surface is roughened by irregular, low, somewhat sinuous, obsolescent ridges, between which the cells are placed either singly or in groups. The cells are generally very shallow and indistinct; and the septa are from ten to twenty in number, uniformly very thin and finely granular, often very small, and united with each other. The surface between the cells is of very open and porous texture, having the form of oval or elongated, rectangular, interseptal areas, arranged somewhat as in a spider's web, an arrangement apparently due to an abundant and regular development of synapticulæ.

Locality.—Amboina.

2. *Psammocora obtusangula* (Lamarck).

Pavonia obtusangula, Lamarck, Hist. Anim. sans Vert., ii. p. 240, 1816.
Psammocora obtusangula, Dana, Zoophytes, p. 345.

A large, broken specimen was obtained, which is in all respects typical of the species.

Locality.—Tongatabu.

3. *Psammocora ramosa*, n. sp. (Pl. VI. figs. 6–6*b*).

Corallum consisting of a cluster of numerous, rather thick, elongated, uneven, and somewhat contorted branches which spring from a thick, basal stock; the branches are subterete, much and rather closely divided, not coalescent, from 8 to 12 mm. thick; continued above into short, irregular, compressed, clavate, or palmate branchlets, the terminal divisions being rather thick and obtuse, and often terete; the corallum throughout is somewhat irregularly swollen or nodose owing to unequal rudimentary branches and branchlets. Calicles very small, 0·75 mm. wide, rather distant, superficial, with a minute depression at the centre, in which a very minute tuberculate

columella is sometimes distinguishable. Septa generally eight or nine, very variable, oval or cuneate, and very roughly granulated, thick, often alternately united by the outer part, and thus enclosing the intervening ones. The surface between the cells is divided up into irregular, closely-placed, rounded or oval, septa-like lobes which give a peculiar appearance to the corallum.

This species seems to be close to the *Psammocora parvistella*, Verrill; but the characters of the calicles and the intercalicular spaces will easily distinguish it. The specimen is from about 9 to 10 cm. high, and 10 to 11 cm. wide.

Locality.—Samboangan, Philippines.

Genus 7. *Stephanaria*, Verrill.

Stephanaria, Verrill, Trans. Connect. Acad., vol. i., 1868, p. 545.
„ Duncan, Rev. Madrep., p. 160.

The essential distinction of this genus from *Psammocora* is to be found in the nature of the columella, which is papillary; but it is doubtful whether this character in these forms can be considered sufficient for generic separation.

Stephanaria stellata, Verrill.

Stephanaria stellata, Verrill, Trans. Connect. Acad., vol. i. p. 545, pl. ix. fig. 4.

Two small specimens, apparently referable to this species, occur. They are interesting varieties, in which the branches are more elongated than in the Panama or Californian forms. (Reference to the distribution of this species is made under the genus *Porites*.)

Localities.—Honolulu; Kandavu, Fiji.

Genus 8. *Oxypora*, Kent.

Oxypora, Saville Kent, Proc. Zool. Soc. Lond., 1871, p. 283.

This genus was proposed by Kent for the *Trachypora* of Verrill, the name *Trachypora* being already in use for a distinct genus of fossil Corals. Klunzinger has since proposed *Echinophyllia* for the same genus, but *Oxypora* claims priority. By a slip, this genus has been placed as a synonym of *Phyllastræa* by Professor Duncan, while *Trachypora* is retained.

Oxypora contorta, n. sp. (Pl. V. figs. 2–2*b*).

Corallum large, explanate, suberect and foliate, thin, very contorted, the twisted parts uniting to form large, hollow tubes, which in course of growth become closed above; pierced with irregular openings, which become larger and more numerous towards the margin. The under surface roughly and irregularly costate, the costæ being unequal, slightly thickened, a little prominent, and finely but strongly spinose,

often lacerately divided. The upper surface covered by unequal, narrow, subparallel septo-costal plates, which are very strongly and raggedly divided towards the margin, and scarcely divided at the basal parts except in the immediate vicinity of the calicles. The calicles are from about 5 to 6 mm. in diameter, generally very closely crowded against each other, but sometimes rather scattered; the septa are of two distinct cycles, very unequal, remarkably exsert and deeply divided into narrow, unequal, lacerate lobes and spines, which give a very ragged appearance to the corallum.

The species is close to *Oxypora lacera*, Verrill, but can be easily distinguished, among other characters, by the arrangement and structure of the calicles.

A single large specimen was obtained.

Locality.—Amboina.

Family Fungidæ.

Genus 1. *Fungia*, Lamarck.

Fungia (pars), Lamarck, Syst. Anim. sans Vert., p. 369, 1801.
„ Milne-Edwards and Haime, Cor., iii. p. 5.
„ Duncan, Rev. Madrep., p. 141.

As already pointed out by Professor Duncan, *Lobactis*, *Pleuractis*, and *Ctenactis*, are synonyms of *Fungia*.

Very important observations, confirmatory of those by Stutchbury and by Semper, have been made by Professor Moseley on the development of the young *Fungia*,[1] and it seems extremely desirable to insert here his account of them.

"A Mushroom Coral (*Fungia*) is very common all over the reefs at Tahiti. After much search, I found one of the nurse-stocks from which the disc-shaped free corals are thrown off as buds, as was originally shown by Stutchbury, and confirmed by Semper, who considers the case to be an instance of alternation of generations.

"Though the free Corals were so extremely numerous, I could only find the one nurse mass. It, as in Stutchbury's specimen, consisted of a portion of a very large dead *Fungia*, to which were attached all over numerous nurse-stocks in various stages of growth. Some of those in the specimens have only just developed from the attached larva, and have as yet thrown off no buds. A small cup-like Coral is formed, and as it grows the mouth of the cup widens and assumes somewhat the form of the adult disc-shaped free Coral, but is still distinctly cup-shaped. A line of separation forms in the stem of this bud, and the bud falls off; a fresh bud then starts from the centre of the scar left by it on the stock, and the process is repeated. The fresh bud in its growth does not spread its attachments over the whole surface of the old scar, the margins of which persist as a dead zone around the base.

[1] Notes by a Naturalist on the Challenger, p. 524.

"The line of separation of the second bud does not correspond with that of the first, but is beyond it a short distance. Hence the nurse-stem which has thrown off several buds is transversely jointed in appearance. Some of the stems in the specimens I found showed thus three rings. Stutchbury imagined that each mother stock threw off only one bud and then died; Semper showed that this was not the case, he speaks of three or four generations only being produced by each stock. Apparently the number produced is very limited. None of the stocks in my specimens were branched. A young Coral bud just ripe, $1\frac{1}{6}$th of an inch in diameter, dropped off one of the stocks as I lifted the specimen from the water. Beneath it, on the scar, another very small young *Fungia* had begun to bud out before its predecessor was quite free. The somewhat cup-shaped buds, when set free, become, by the direction in which future growth takes place, flat and disc-shaped and develop eggs, from which spring free-swimming larvæ, which start fresh stocks.

"The mass of nurse-stocks which I found was surrounded on the reef by a group of fully-formed Fungias of all sizes; I counted twenty in all. Some six of these were small and still showed the scar of attachment which disappears in the process of subsequent growth."

An essential part of the definition of *Fungia* is, that in the adult state the animals are simple forms; and normally this is the case. It very frequently happens, however, that specimens are found in which two or even three distinct mouths are present in the same specimen, and examples of this are found in the collection; but a careful examination shows that this arises from interrupted growth or injury, and must be looked upon as accidental and not normal to the genus.

Professor Duncan has very thoroughly investigated the structure of the hard parts of *Fungia* and other allied genera, with especial reference to the structure and nature of the synapticulæ, which were considered by Milne-Edwards and Haime to be structures analogous to extremely developed granules.

These synapticulæ, he concludes, "are not hypertrophied granulations, from which they differ in shape, position, and structure."[1] Professor Duncan considers that they are independent structures, which by their fusion with one another and with the septa give rise to the basal wall. Thus, "it appears that synapticulæ are formed either prior to or simultaneously with the septum, for they and it contribute to the basal wall before the septum has increased much in height;"[2] "they (*i.e.*, synapticulæ) increase beyond the normal dimensions towards the base, and unite in a homogeneous mass composing the basal wall;"[3] "the section indicates that the wall is composed of more or less horizontal or curved synapticulæ, thicker than others, above."[4]

While it seems proved that these synapticulæ are not hypertrophied granules, but structures independent of the granules, it seems to me that, instead of being independent structures which give rise to a basal wall, it is likely, if not more probable, that they are modified or specialised portions of the wall itself, which thus gives rise to synapticulæ

[1] *Journ. Linn. Soc. Lond.* (Zool.), vol. xvii. p. 147. [2] *Ibid.*, p. 145. [3] *Ibid.*, p. 147. [4] *Ibid.*, p. 144.

instead of being derived from them. This indeed seems borne out by the structure of the corallum of the very young forms which are still attached to the nurse-stock. In these the walls are well developed and almost imperforate, while the synapticulæ are comparatively undeveloped. Additional evidence for this view can also be drawn from the relation of the synapticulæ to the wall in many forms of the Cycloseridæ and Plesiofungidæ, in which, while it is convenient and is customary to speak of the walls of the smaller developing calicles as being formed by the upgrowth, the increase in size, and the fusion of the synapticulæ (as though these structures were distinct from the wall in their origin), it must be remarked that the synapticulæ appear to be direct interseptal outgrowths of the wall (as in *Agaricia*, *Tichoseris*, *Domoseris*, &c.); so that the statement that the walls are synapticulate, or that the walls are formed by the fusion of synapticulæ, would appear to mean nothing more than that the different parts of the wall which are deposited separately (and are then called synapticulæ) enlarge during growth and fuse to form a solid, more or less continuous mass, which is the more commonly known "wall."

It must be confessed, however, that conclusions as to the relations of these parts are practically but guesses at the truth of the matter; proofs of such relations in this, as in so very large a number of other cases among the Corals, can only be obtained when the development of these different structures from the soft parts in the young forms have been thoroughly investigated.

A remarkable degree of variation seems to characterise the different forms of *Fungia*, as is well evidenced by specimens in the collection; and our knowledge of constant specific characteristics and limitations, if such indeed exist, is very imperfect in these as well as in the other Reef-Corals.

From their great size and weight, and their unattached condition, the species of *Fungia* offer apparently the most suitable examples on which continuous and detailed observation and experiment may be made; while their remarkable abundance and peculiarly favourable position on the reefs at Banda and Tahiti would seem to point to such localities as being the best adapted to such investigation. It is certainly a promising field for any naturalist who, with time and means at his disposal, would devote himself to it.

Thirteen species of this genus are in the collection.

1. *Fungia patella* (Ellis and Solander).

Madrepora patella, Ellis and Solander, Zoophytes, p. 148, pl. xxviii. figs. 1, 2, 3, 4.
Fungia agariciformis, Leuckart, De Zooph. Corall., p. 42, pl. iv. figs. 1–4.
„ *agariciformis*, Dana, Zoophytes, p. 292, pl. xviii. figs. 5, 6.
„ *patella*, Milne-Edwards and Haime, Cor., iii. p. 8.
„ *patella*, Klunzinger, Cor. roth. Meer., p. 61, pl. vii. fig. 4, and pl. viii. fig. 2.

Some very large and two small specimens of a variety of this common species were obtained. The septa are very thin at the upper border, with very small teeth. The

basal parts of the septa are much thicker, and the costæ are rather thick, crowded, and subequal, with strong and pointed spines, especially in the old specimens. One small specimen from Mactan Island shows well the scar of attachment.

Fungia pliculosa, Studer, is extremely close to this species, and is probably not distinct from it.

Localities.—Banda; Mactan Island, Philippines; Amboina.

2. *Fungia discus*, Dana.

Fungia discus, Dana, Zoophytes, p. 291, pl. xviii. fig. 3.

A large series of specimens was collected, which present considerable differences among themselves, but which are evidently only varieties of the same species. The corallum may be nearly flat on both sides or convex, and often strongly so; the costæ may be slightly or very prominent, distinctly radiate to the very centre or almost obsolete, with obtuse or almost subacute, irregularly crowded, or scattered spines, which are sometimes nearly suppressed; the septa may be thin or much thickened and dense, straight or slightly crinkled and closely plicate, strong or subfragile, very closely placed with an even appearance, or more unequal and irregular, with very irregular teeth, which are either small or large, acute and narrow, or broad and subdivided at the apex into very minute denticulations. Owing to this great variation in the species, some forms seen separately seem almost sufficiently distinct to be made separate species, but in the series it is impossible to separate them.

One specimen of this species in the collection, the corallum of which has been broken in three distinct places, possesses three mouths situate at the points of fracture, and shows very clearly the formation of new mouths by the animal during subsequent growth after injury of considerable extent to its structure has taken place.

To this species belongs the nurse mass obtained and described by Professor Moseley.[1]

Locality.—Tahiti.

3. *Fungia concinna*, Verrill.

Fungia concinna, Verrill, Bull. Mus. Comp. Zoöl., Cambridge, U.S.A., vol. i. p. 50.

Two specimens of this species were obtained. They agree in every essential respect with the description of Verrill, but they differ slightly in that the teeth of the septa are unequal, many small, acute teeth being often found between the large acute ones, and not infrequently passing gradually into one another.

The species is extremely close to the larger-toothed, convex forms of the *Fungia discus*, while, as pointed out by Verrill, it is also allied to the *Fungia repanda*. In the three species the peculiar ornamentation of the lateral surfaces of the septa is the same,

[1] Notes by a Naturalist on the Challenger, p. 524.

and takes the form of minute granules or spinules below, becoming more or less striate in wavy lines, often thickened, which follow the dentation of the septa. Though apparently distinct, it seems likely that the three species are but extreme forms of one and the same species.

Locality.—Tahiti.

4. *Fungia repanda*, Dana.

Fungia repanda, Dana, Zoophytes, p. 295, pl. xix. figs. 1, 2, 3.

One specimen from Amboina has the septa quite thick, solid and strong, and not infrequently with a sharp somewhat trenchant edge. A series of specimens from Banda shows a very great variation, in which the septa become gradually thin, and, especially in the smaller specimen, quite fragile and delicate. A small specimen of this series presents marked differences in its delicate characters from the ordinary form of the *Fungia repanda*, but viewed in the series to which it belongs it is impossible to separate it.

Localities.—Amboina; Banda; Mactan Island, Philippines.

5. *Fungia confertifolia*, Dana.

Fungia confertifolia, Dana, Zoophytes, p. 297, pl. xix. fig. 5.

Two specimens of this species were obtained. The extremely crowded, even, and undulate lamellæ are very characteristic; in young specimens where the lamellæ are thinner, wider apart, and more unequal, the species very closely resembles the *Fungia patella*, but with age the septa become quite thick, with strong teeth, and the costal spines quite long and large. Distinctly raised tentacular teeth are present, but they are never strong and thickened as in *Fungia dentigera*. A very common characteristic, generally found on several parts of the specimen, is the unequal and suppressed nature of certain septa, resulting in the convergence and coalescence of the outer ends of the septa on each side. A moderately large, interesting variety from the Fiji Islands shows the septa much thickened, bearing rather large, blunt, irregular teeth.

Localities.—Banda; reefs, Fiji.

6. *Fungia horrida*, Dana.

Fungia horrida, Dana, Zoophytes, p. 298, pl. xix. fig. 7.

Two specimens were obtained which, though differing in a few points from those described by Dana, seem referable to this species. The costæ are prominent, sub-lamellate and thick, deeply divided into long, often contorted and branched spines, which, in old specimens, become very crowded, irregular and thickened, and are often placed over the whole of the lower surface. The septa are thick, and very roughly

divided, those of the last cycle less distinctly so. They are not closely crowded, and are rather unequally raised. The tentacular teeth are not developed on any of the septa. The whole corallum has a very dense and compact structure.

In the smaller of the two specimens a second mouth has formed at a short distance from the centre, just where a fracture of the corallum has taken place.

Locality.—Tahiti.

7. *Fungia valida*, Verrill.

Fungia valida, Verrill, Bull. Mus. Comp. Zoöl., Cambridge, U.S.A., vol. i. p. 51.
Fungia valida, Klunzinger, Cor. roth. Meer., iii. p. 62, pl. viii. figs. 7, 8.

A single large specimen was obtained, which seems referable to this species. It differs from the Indian Ocean form in its much more unequal septal teeth, which are less acute and are often rounded.

The species has many points of agreement with the *Fungia horrida*, but differs in the more unequal septa and in the form of the septal teeth, which in that species are eroso-dentate and irregular.

Locality.—Reefs, Fiji.

8. *Fungia acutidens*, Studer.

Fungia acutidens, Studer, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, 1877, p. 649, pl. iv. fig. 13.

Three specimens of this species were collected. The costæ are very distinct and very uniformly radiate, extending nearly to the centre, and sublamellate and prominent towards the margin, evenly divided into cylindrical blunt spines, the ends of which are very granulated or finely spinulose. In young specimens the centre is nearly bare.

The species is close to the *Fungia horrida*, but differs in its less remote, thinner, and less unequal septa, and in its closer and more regular, spinose costæ.

Locality.—Tahiti.

9. *Fungia rugosa*, n. sp. (Pl. VI. figs. 2–2*a*).

Corallum circular, somewhat undulate, slightly concave below and convex above. Costæ in distinct radial rows nearly to the centre, very unequal; the larger costæ, for about half the radius, are very prominently lamellate, rather thin at the margin, becoming less lamellate within and thickened, not continued to the centre (except probably in large and old specimens); alternating with these large costæ are others which are nearly as large, less prominent and less prolonged, while between them are placed from three to four

very small ones, which are only distinct quite at the margin, where they are separated by long slits; the surface below is very slightly perforated, having a very dense and smooth appearance, especially at the centre, which is very sparsely marked with small costal spines (probably much enlarged in old specimens); the spines on the costæ are very irregular, crowded, ragged, elongated, often 5 mm. or more in length, bent or contorted, and often clustered and divided; they are slender or thickened, not sharp, but more or less divided at the apex into numerous fine, irregular spinules, which are also sparsely placed throughout the length of the spines and are faintly visible to the naked eye. Seven cycles of septa complete, an eighth more or less incomplete. The septa are rather thin, unequally thickened at the central part, becoming nearly equal at the margin and more or less equally raised, except those of the last cycles; the primaries and secondaries equal, very suddenly thickened near the inner margin, where those of opposite sides are closely approximated, so as nearly to touch above; the tertiaries nearly as large. The teeth of the septa are peculiar; the margin of the free border of the septa is slightly wavy, and the teeth appear as the projecting ends of opposite lateral thickenings, which are continued downwards on the face of the septa for about 3 or 4 mm. Except on the last cycle, the teeth are subequal, crowded, somewhat irregular, rather short, small and acute, but finely pointed, being broader across than in the direction of the septa. Fossa elongated, narrow above, but rather wide below, owing to the crescentic shape of the septal ends; columella rudimentary.

This species is very distinctly marked both by the characters of its costæ and of its septa. The waviness and plication of the margins of the septa recall the structure often seen in delicate specimens of *Fungia patella*, while the nature of the teeth brings to mind *Fungia scruposa*. The costal characters resemble those of *Fungia horrida* in many respects.

Two specimens were obtained, which are from about 10 to 11 cm. in diameter.

Locality.—Tahiti.

10. *Fungia plana*, Studer.

Fungia plana, Studer, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, 1877, p. 650, pl. iv. fig. 15.

A single specimen of this species was obtained. It is somewhat elongated and quite flattened. The species is extremely close to the *Fungia serrulata*, Verrill, and probably it is not distinct from it.

Locality.—Banda.

11. *Fungia scutaria*, Lamarck.

Fungia scutaria, Lamarck, Hist. Anim. sans Vert., ii. p. 236, 1816.
„ „ Dana, Zoophytes, p, 301, pl. xix. fig. 10.
„ „ Klunzinger, Cor. roth. Meer, iii. p. 65.

A very fine series of specimens of this species was obtained. In some specimens the corallum is much elongated, while in others it is subcircular or subtriangular with rounded edges. They are usually much thickened, especially so with age. The costæ are generally very distinctly radiate to the very centre, close and prominent, divided into rather blunt, papilliform teeth, which are very closely crowded, The septa are rather thin, subentire or finely toothed, the teeth being small, crenulate, or broadly angular, especially towards the margin of the corallum. In other specimens, however, the costæ are less prominent and less crowded, with fewer, sharper spines, which are more or less sparse over the centre, while the septa become thinner and more sharply and finely toothed. On account of these characters it must be observed that the species becomes very similar to *Fungia paumotensis*, and it is a matter of great difficulty to distinguish between them.

Fungia carcharias, Studer, is apparently identical with this species.

Figures, apparently of this species, showing the form of the corallum, are given both by Seba[1] and by Rumphius,[2] while a very good description is given by Dana. The distinction given by Milne-Edwards and Haime[3] between this species and *Fungia paumotensis* is confusing, and seems to be the reverse of what is really the case.

Locality.—Tahiti.

12. *Fungia paumotensis*, Stutchbury.

Fungia paumotensis, Stutchbury, Trans. Linn. Soc. Lond., vol. xvi. p. 485, pl. xxxii. fig. 6, 1833.
„ „ Dana, Zoophytes, p. 300, pl. xlix. fig. 8.

It is with extreme doubt that I have retained this species. It seems to me to be only a variety of *Fungia scutaria* with the corallum more elongated and flattened, with the costæ less prominent and less closely placed, bearing smaller, sharper and more distant papillæ less radiate on the centre, and with rather thinner septa, which are subentire or lined with extremely fine teeth. Numerous specimens of the species were obtained, some of which are more or less intermediate in characters between the more defined forms of the two species. Professor Martin Duncan has already pointed out the extremely close relationship of the two species.[4]

Localities.—Tahiti; Samboangan, Philippines.

[1] Thes., iii. pl. cxii. figs. 28, 29, 30.
[2] Herb. Amboin, vi. pl. lxxxviii. fig. 4.
[3] Cor., iii. p. 17.
[4] *Journ. Linn. Soc. Lond.* (Zool.), vol. xvii. p. 146.

13. *Fungia tenuidens*, n. sp. (Pl. VI. figs. 1 1*a*).

Corallum irregularly elongated, rather thin, convex above, markedly trough-shaped below; the central portion more or less flattened, solid, and seldom or inconspicuously perforated, covered by distinctly radiated and sharply spinulose costæ which become very distinct at the inclined margin. The growth at the margin more or less irregular, owing to the elongation and approximation of certain septa and the partial or complete suppression of others between them, with or without the union of the adjacent ones. Septa of very many cycles, very unequal in length, closely crowded and even, extremely thin and delicate, very flexuous, with their sides strongly granulated, especially in the smaller ones, and marked above by very minute serrations. The tentacular teeth very exsert and distinct, developed even in the last cycle, very thin, scarcely or not at all thicker than the septa, more or less rounded. Fossa elongated, rather narrow and deep; columella rudimentary.

A single small specimen, which is from about 8 to 9 cm. long, of this very distinct form was obtained. It must be placed close to *Fungia conferta*, Verrill. The very thin, delicate and flexuous septa, the very exsert and distinct but scarcely or not at all thickened tentacular teeth, the very irregular outline of the corallum, due to the unequal elongation of certain septa and the diminution or suppression of those between them, give a striking appearance to this species.

Locality.—Ternate, Moluccas.

Genus 2. *Halomitra*, Dana.

Halomitra; Dana, Zoophytes, p. 341.

This genus has lately been extended by Professor Duncan to include *Podabacia* of Milne-Edwards and Haime,[1] since, on the authority of those authors, it is stated that *Halomitra* differs from *Podabacia* simply in its general form, and in its unattached condition:[2] characters which, as Professor Duncan points out, are not sufficient for generic separation. Between *Halomitra pileus*, Dana, and *Podabacia crustacea*, however, there exist very important and striking differences apart from the simple difference in their habit, differences which entitle them to generic separation, and which were confounded by Milne-Edwards and Haime, owing to the fact that under the *Fungia pileus*, Lamarck (and under the *Halomitra pileus* of Milne-Edwards and Haime), were included two correspondingly distinct, but similarly-shaped, types of structure.

The genus *Halomitra*, as defined by Dana, is certainly a well-characterised one; and an essential part of the definition, which separates the genus from *Podabacia*, is derived from the nature of the wall and costæ. In the definition given by Dana, the under surface is tersely stated to be "*stoutly and very crowdedly radiately echinate*," that is, the wall is solid and but very slightly perforated, while the costæ form distinct,

[1] *Journ. Linn. Soc. Lond.* (Zool.), vol. xvii. p. 155. [2] Cor., iii. p. 20.

close and thick, radiating structures, which are divided up into strong spines or teeth, so as to be stoutly and crowdedly echinate. In fact, the condition of the wall and costæ, in this compound form, exhibits the closest resemblance to that which obtains in the simple genus *Fungia*, a form from which *Halomitra* may at once be derived by the development of secondary or daughter calicles around the central primary calicle.

Comparing this characteristic condition of *Halomitra* with that which obtains in the species for which the genus *Podabacia* was instituted by Milne-Edwards and Haime, namely, the *Madrepora crustacea*, Pallas (=*Pavonia explanata*, Dana), we find an essential and fundamental distinction. This was clearly recognised by Dana, who states that the under surface is "*echinulato-striate and porous*," that is, that the wall is not solid, but finely and closely porous or fissured throughout, while the costæ are in the form of distinct striations, the course of which is indicated by the fine denticulations or echinulations of which they are composed, and the radial arrangement of which is generally much obscured: a condition comparable to that which obtains in *Lithactinia* rather than in *Fungia*.

Concerning this form (*Pavonia explanata*, Dana=*Podabacia crustacea*), Dana writes: "this species might well form a distinct genus. It looks much like an inverted *Halomitra*," a statement that is altered to a considerable extent by Milne-Edwards and Haime, who, in writing of the same species, say, "il se trouve indiqué dans l'ouvrage de M. Dana, qui le définit très-justement en l'appelant une Halomitre retournée et pédonculée." The genus *Podabacia* was certainly well instituted for this very distinct form.

The confusion between the genera *Podabacia* and *Halomitra* has arisen from the fact that there exist specimens which, while they have the characteristic *shape* of *Halomitra pileus*, yet possess the *structure* of *Podabacia crustacea*, as exemplified in the characters of the wall and costæ: specimens which are clearly referable to *Podabacia* (amended so as to include free as well as fixed forms).

From this it will be seen that we have no means of determining whether the *Mitra polonica* of Rumphius, which is usually regarded as being the *Halomitra pileus*, is really referable to *Halomitra* or *Podabacia*.

The *Halomitra pileus* of Dana is undoubtedly the *Madrepora pileus* of Pallas, whose description must certainly have been drawn up from a specimen of *Halomitra* and not of *Podabacia*. The description of Lamarck would apply equally well to either of the equiform specimens of *Halomitra* and *Podabacia*, and have included them both; while the redescription of Milne-Edwards and Haime was evidently drawn up from specimens of both of these types and is more applicable to the *Podabacia* than to the *Halomitra* form.

So that while, on the one hand, the specific term *pileus* must apply to the *Halomitra* (*Madrepora*) *pileus*, Pallas (=*Halomitra pileus*, Dana), it is desirable, on the other hand, to retain it also for the equiform *Podabacia*, which would, therefore, stand

as the *Podabacia pilcus* (=*Fungia pileus*, pars), Lamarck (=*Halomitra pileus*, pars, Milne-Edwards and Haime).

Halomitra tiara, Verrill.

Halomitra tiara, Verrill, Bull. Mus. Comp. Zoöl., Cambridge, U.S.A., vol. i. p. 53.

A small specimen was obtained which seems referable to this species, though differing in many characters from the description of the adult form. It is about 6 cm. in diameter, irregularly concave below and convex above, with a single large, central parent calicle, which becomes in the adult form indistinguishable from the younger ones which develop around it. The costæ are scarcely distinct at the centre but they become more distinct with age, and the narrow, elongated, pointed, costal spines become larger. The calicles are often very crowded and separated only by a few, short, narrow plates which are often undivided and appear quite broad in comparison with the pointed and rather narrow septal teeth. Around the axial cavity the septa are often broad, being almost or quite undivided, but with age they become more divided, prominent and pointed.

The species is very close to *Halomitra pileus* (Pallas), and may not be distinct from it.

Locality.—Mactan Island, Philippines.

Genus 3. *Podabacia*, Milne-Edwards and Haime.

Podabacia, Milne-Edwards and Haime, Cor., iii. p. 19.

The essential distinctions between *Podabacia* and *Halomitra* have been discussed under the latter genus. A not unimportant, additional point of difference between the two genera is to be found in the arrangement and dentation of the septa. In *Podabacia* the septa are evenly and closely placed, not markedly prominent around the fossa, while the teeth are small and do not give a markedly rough, irregular aspect to the corallum. In *Halomitra* the septa are markedly unequal, and very prominent around the fossa, while the teeth are very large, pointed and irregular, and give to the corallum a very rough and bristling aspect.

As now understood the genus is extended to include unattached as well as fixed forms. It includes the following three species :—

Podabacia crustacea (Pallas).
Podabacia pileus (Lamarck).
Podabacia robusta, n. sp.

The last is founded on a specimen in the collection.

Podabacia robusta, n. sp. (Pl. VI. figs. 5–5*b*).

Corallum subcircular, or irregularly elongated, convex above and concave below, strong and thick. The under surface extremely perforated and marked by radial,

irregularly bent and confluent, subdistinct costæ, which are thin at the marginal part of the corallum and thicker at the central portion, and are covered by closely crowded, small, blunt, extremely granulated papillæ, which are arranged more or less irregularly and often in small clusters. Calicles very distinct, apparently arranged around a central calicle, irregularly placed, sometimes crowded but generally separated by spaces of from 6 to 15 mm. Fossa small, subcircular or oval, very distinct owing to the close and even arrangement of the ends of the septa around it. Septa of three cycles, very distinctly radiate, continuous between adjoining calicles, very oblique at the inner part and much raised between the cells which thus become placed in wide depressions; the primaries and secondaries thick, with a rather sharp edge, which is irregularly divided and very granulated, with rather small teeth; the smaller septa very thin, crenulate and granulated; all the septa are evenly and closely placed, thus giving a neat and even appearance to the corallum. Columella slightly papillose, rudimentary.

A single specimen of this species was obtained. It is especially interesting as presenting a case of the development of a complete corallum from a fractured portion. The original piece with the costæ running in one direction forms the central portion of the specimen, the costæ of the lateral portions of the later growth being directed at right angles to those of the original piece from which they are developed.

The long diameter of the specimen is about 20 cm., and its thickness about 2 cm.

Locality.—Amboina.

Genus 4. *Cryptabacia*, Milne-Edwards and Haime.

Cryptabacia, Milne-Edwards and Haime, Cor., iii. p. 22.
„ Duncan, Rev. Madrep., p. 144.

The distinctness of this genus from *Polyphyllia* is extremely doubtful, since one species, *Polyphyllia substellata*, is known which is almost transitional.

Cryptabacia talpina (Lamarck).

Fungia talpina, Lamarck, Syst. Anim. sans Vert., p. 370.
Polyphyllia talpa, Dana, Zoophytes, p. 313, pl. xxi. fig. 5.
Cryptabacia talpina, Milne-Edwards and Haime, Cor., iii. p. 22.

The species seems to be very variable in the degree of distinctness of the median series and of the lateral calicles, in the prominence, size, and degree of dentation of the septa, and in the shape of the corallum. The ends may be pointed with the median series continued to the extremity, or more or less rounded with the median series suppressed. A slightly curved, long, broad, and pointed specimen was obtained. Tolerably good figures are given by Seba.[1]

Locality.—Amboina.

[1] Thes., iii. tab. cxi. No. 6, and tab. cxii. No. 31.

Genus 5. *Lithactinia*, Lesson.

Lithactinia, Lesson, Illustr. Zool. Paris, 1831.
„ Milne-Edwards and Haime, Cor., iii. p. 28.
„ Duncan, Rev. Madrep., p. 146.

This genus is undoubtedly very closely related to *Polyphyllia*. Very few forms of the two genera are known on which to base comparisons, and of these it is certain that injury to the colony during the growth of many of them has considerably interfered with and obscured the true character of the form. Owing to the very porous and fissured structure of the basal wall, and to the thinness of the corallum in these specimens, which are all unattached, such injury with consequent malformation is very liable to occur.

Two species are in the collection.

1. *Lithactinia pileiformis* (Dana).

Polyphyllia pileiformis, Dana, Zoophytes, p. 317, pl. xxi. fig. 4.

Two specimens were obtained. They are dish-shaped or basin-shaped, with one side much drawn out, so as to give in the larger specimen a length of 15 cm. and a breadth of 9 cm. Both specimens are peculiar in that they give the appearance of having been broken during life, while growth has continued around the edges of a rather large fractured piece, so that the added portion is continuous with the original part. This is borne out by the fact that the septa and costæ in the lateral pieces are not in the same line with those of the more central portion and do not radiate from a common centre, but are directed more or less at right angles to them. In both specimens also, and apparently confined to the original fractured piece, a very short, more or less subradiate, calicular trench is indicated, but not placed so as to be median to the whole corallum. The costæ in this species are very distinct, denticulate and rough, irregularly confluent, and separated by narrow, elongated fissures.

Locality.—Reefs, Fiji; brought alongside the ship by natives off Kandavu.

2. *Lithactinia galeriformis* (Dana).

Polyphyllia galeriformis, Dana, Zoophytes, p. 317, pl. xxi. fig. 3.

Two specimens were obtained. One, the larger, is conically cap-shaped, drawn out laterally so as to give a length of nearly 13 cm. and a breadth of nearly 9 cm. The second is smaller and broadly saucer-shaped, but irregular. They both present the same appearance, due to fracture, as in the *Lithactinia pileiformis;* but there is in no part any indication of a subradiate calicular arrangement.

The species is very close to the preceding, but differs markedly in its much thinner

and more delicate corallum, in its thinner, smaller, and shorter septa, and in the much less distinct costæ, which are finely denticulate, very confluent, and irregularly separated by short fissures.

Locality.—Reefs, Fiji; brought alongside the ship by natives off Kandavu.

Genus 6. *Herpetolitha*, Eschscholtz.

Herpolitha, Eschscholtz, Isis, p. 746, 1825.
Herpetolitha, Milne-Edwards and Haime, Cor., iii. p. 23.
Herpolitha, Duncan, Rev. Madrep., p. 145.

The structure of the corallum in this genus has been investigated in detail by Professor Duncan.[1]

Herpetolitha crassa, Dana.

Herpetolithus crassus, Dana, Zoophytes, p. 310, pl. xx. fig. 5.

A single very large specimen of this species was obtained. Though close to the *Herpetolitha limax*, it seems to be fairly distinct. The description and figure given by Dana are very good.

Locality.—Banda.

Genus 7. *Sandalolitha*, Quelch.

Sandalolitha, Quelch, Ann. and Mag. Nat. Hist., vol. xiii., 1884, p. 294.

Corallum compound, flattened, free, much elongated and very thin. Wall sparsely perforated and extremely reduced; costæ distinct, fine, subequal, closely granulated or very finely and bluntly echinulate, curving towards the short axis. Calicles few, in the long diameter of the corallum; parent calicle very large, occupying the centre, forming almost the entire corallum, with very numerous septa, there being about seven complete cycles, a much larger number of cycles being developed in the long axis of the corallum; smaller calicles very few, distinctly radiate, developing in the course of and interrupting the larger septa in the long axis of the parent calicle. The septa are crowded and very long, curving towards the short axis, and of more or less equal vertical extent, very low, giving an even laminate appearance to the corallum. Synapticulæ well developed and forming strong connections at the basal parts of the septa. Columella rudimentary and trabecular.

This genus is related to *Zoopilus*, *Halomitra* and *Podabacia*. With *Podabacia* it closely agrees in the nature of the costæ, though the rays are more continuous owing

[1] *Journ. Linn. Soc. Lond.* (Zool.), vol. xvii. p. 152.

to the much less porous condition of the wall. With *Halomitra* it agrees in the nature of the septal teeth, and in the size and distinctness of the parent calicle; but it is easily distinguished by the costal rays, which are fine and do not form strong and thick lamellæ with coarse spines, by its manner of growth with high septal cycles on the long axis, by the development of few smaller calicles in the longitudinal axis, and by the reduced wall. From *Zoopilus*, to which it seems to be more closely related, it is distinguished by the possession of a distinct, large, central calicle, by the development of fresh calicles in the course of the long axis close to the parent calicle and interrupting the larger as well as the smaller septa, and by the costæ, which are fine and not prominent nor divided into strong clustered teeth. In the specimen of *Zoopilus* figured by Dana, there is a distinct central depression, but this is stated by him to be an "accidental distortion and not the position of a medial orireme." In the absence of such a central calicle, the nature of the long, large, radiating, uninterrupted septa remains incomprehensible.

Sandalolitha dentata, Quelch (Pl. VII. figs. 1–1*d*).

Sandalolitha dentata, Quelch, Ann. and Mag. Nat. Hist., vol. xiii., 1884, p. 295.

Corallum almost flat, irregularly sandal-shaped, fragile, translucent, being about 6 mm. thick, except immediately around the mouth of the central calicle where the septa are somewhat elevated and thickened. The parent calicle attains a large size, nearly 15 cm. in length, before the smaller calicles are developed. Wall very thin, pierced with numerous small pores; costæ slightly unequal, with very small, granulated, blunt spines, distinct, curving in radiating lines towards the short axis of the corallum except at the centre, where the costal spines become crowded over a thickened circular space that seems to have been a former base of attachment. Septa of the central calicle of seven complete cycles, but incomplete orders are developed at the extremities of the long axis of as many as sixteen cycles; those of the first three cycles subequal, slightly thickened and prominent at the centre; and, with the exception of the very small ones, all the septa are nearly equally raised over the general surface, cut into strong, long, and narrow teeth, very granulated, especially at the apex of the teeth; the teeth are obtuse or pointed, the extremity being subdivided into pointed spinules. The septa of the higher orders unite, one on each side, with one of a lower order at that part of it from which they originate. Columella rudimentary.

Only a single specimen of this species was obtained. It is rather bent to one side, about 15 cm. long and 6·5 cm. wide, narrowing slightly towards the extremities and rounding off suddenly. At the centre, where the septa are raised, it is about 15 mm. thick, and, except at this thickened portion, the corallum is quite translucent. The under portion is marked with many concentric, curved undulations, elongated in the direction of the long axis, following the growth of the corallum. In one direction of its

length a primary septum corresponds exactly with its median axis, but on the other the septum has curved to one side at a distance of about 15 mm. from the median axis. Besides the large parent calicle, there are five other calicles which are more or less distinctly developed. Of these the most perfect is situated close to the central one, and interrupts the course of the primary septum in the long axis. The other four are incompletely developed, and are situated between the smaller septa, where two of these are attached to a septum of a lower order; a widening of the interseptal space takes place at this point, and lateral thickenings, with incurving of the adjoining larger septa, indicate the formation of new septa for the developing calicle, which becomes complete when final division of the large septa takes place at the point of incurving.

The long, fragile, nearly flat and thin corallum; the closely packed, even, rather thin and long septa; the large median calicle, with smaller calicles almost unperceived at a first glance, give a striking habit to this form and easily separate it from all others.

Locality.—Tahiti.

Section MADREPORARIA PERFORATA.

Family EUPSAMMIDÆ.

Genus 1. *Rhodopsammia*, Semper.

Rhodopsammia, Semper, Zeitschr. f. wiss. Zool., Leipzig, 1872, p. 257.
" Duncan, Rev. Madrep., p. 182.

A single species of this genus was obtained. The anatomy of this form has been investigated in detail by Mr G. Herbert Fowler.[1]

Rhodopsammia parallela, Semper.

Rhodopsammia parallela, Semper, Zeitschr. f. wiss. Zool., Leipzig, 1872, p. 258, pl. xix. figs. 1–4.

Several specimens of this species in the collection show interesting differences from those described by Semper. In the largest calicles five complete cycles are present, while at the extremities of the long diameter orders of a sixth cycle are to be found. The primary and secondary septa are scarcely thicker than the smaller ones, much less so than is shown in Semper's figure (fig. 4). The separate calicles are much less suddenly

[1] *Quart. Journ. Micr. Sci.*, new ser., October 1886.

pointed towards the base, being more elongated; and in the smaller calicles the shape of the cup is regularly oval.

From these points it will be seen how extremely close the species is to the *Rhodopsammia ovalis*, from which it appears to differ in having the larger septa strongly granulated.

Localities.—Samboangan, Philippines, 30 fathoms; Arafura Sea, 49 fathoms.

Genus 2. *Dendrophyllia*, Blainville.

Dendrophyllia, Blainville, Dict. d. Sci. Nat., lx. p. 319.
Dendrophyllia et *Cœnopsammia*, Milne-Edwards and Haime, Cor., iii. pp. 112, 125.

Verrill has already pointed out that the genus *Cœnopsammia* cannot be kept distinct from *Dendrophyllia*.[1] Professor Duncan has made it a subgenus,[2] but it seems to me that it should be sunk altogether in *Dendrophyllia*.

Four species were obtained.

1. *Dendrophyllia axifuga*, Milne-Edwards and Haime.

Dendrophyllia axifuga, Milne-Edwards and Haime, Cor., iii. p. 119.

A small but well-preserved fragment of this species was obtained. Its very characteristic mode of growth easily serves to distinguish it from all other species of the genus.

Locality.—Wednesday Island, Torres Strait, 8 fathoms.

2. *Dendrophyllia conferta*, n. sp. (Pl. VII. figs. 2–2*b*).

Corallum consisting of an elongated main stem which is essentially the parent calicle, from which, on all sides, numerous, closely-packed, long calicles arise as branches to form a nearly flat-topped clump. The branch-like calicles again bear corresponding calicles like branchlets, and, at the upper parts especially, they are crowded with short buds which are scattered irregularly around them. The calicles never remain short, but elongate to form branches and branchlets. Owing to the close crowding of the branch-like calicles, many of them coalesce laterally throughout a greater or less extent of their length. The older calicles subcircular, from 5 to 8 mm. deep and from 10 to 12 mm. wide (the younger ones much less), of nearly the same diameter throughout all their length, but turbinated at the base, the point of junction with the branches being rather narrow. The small developing calicles markedly turbinate. Costæ very distinct, unequal, generally alternately large and small, denticulate. Septa included, thin, almost entire, finely and pointedly granulous; four cycles complete in the larger cups, occasionally

[1] Dana, Corals and Coral Islands, p. 336.

[2] Rev. Madrep., p. 178.

rudiments of a fifth occur; septa of the first and second cycles broad, prominent, and subequal, those of the fourth narrow, curving, and generally meeting those of the third at some distance from the abundant and spongy columella.

This species recalls *Dendrophyllia surcularis*, Verrill, in many of its characters, but is easily distinguishable from it. The clump in the collection is about 12 cm. high, and a little wider than its height. When viewed from above the specimen has much of the appearance of a colony of *Astroites calyculuris*, owing to the extremely packed arrangement of the calicles, which rise to the same level and are often united, though never so much so as to give rise to a simple wall.

Locality.—Australia.

3. *Dendrophyllia diaphana*, Dana.

Dendrophyllia diaphana, Dana, Zoophytes, p. 389, pl. xxx. fig. 3.

A very small colony of this rather delicate species was obtained.

Locality.—Kandavu, Fiji.

4. *Dendrophyllia equiserialis* (Milne-Edwards and Haime).

Cœnopsammia equiserialis, Milne-Edwards and Haime, Cor., iii. p. 129.

A small and rather delicate specimen occurs in the collection. It differs from typical specimens of the species in that the septa of the third and fourth cycle are extremely narrow.

Locality.—Samboangan, Philippines.

Family Madreporidæ.

Genus *Madrepora*, Linnæus.

Madrepora, Linnæus, Syst. Nat., ed. x. p. 793.
„ Dana, Zoophytes, p. 431.
„ Duncan, Rev. Madrep., p. 183.

An extremely interesting new species (*Madrepora mirabilis*) in the collection presents a combination of characters hitherto unknown in the genus. While the greater number of apical calicles are of the ordinary type with twelve septa, others possess three cycles of septa, and these in a few calicles are all well developed (Pl. X. fig. 5*a*). This is certainly a most striking deviation from the normal condition in the genus; and if it had been common to all the apical calicles in the specimen of *Madrepora mirabilis*, it might have been regarded as a sufficient characteristic for generic separation. Consider-

ing the mode of its occurrence, however, it can only be looked upon as a remarkable variation in the characters of *Madrepora*.

Another curious feature in this same species is the condition of two of the septa in a large number of the lateral calicles. Two opposite septa are not only enlarged, as is often the case in many species of *Madrepora*, but become distinctly exsert and sometimes considerably so. In other calicles no trace of this exists.

In many species of the genus more or less marked differences exist between the terminal and lateral calicles, but, apart from the suggestive fact that in many species no such differences exist, it must be remarked that the terminal and lateral calicles are subject to considerable variation among themselves; so that it does not seem possible to regard the terminal polyps as presenting a case of dimorphism. Verrill remarks that dimorphism is unknown among the *Madreporaria* unless the terminal polyps of *Madrepora* be regarded as offering such a case.[1]

Two important papers, relating, among other things, to growth and budding in *Madrepora*, have recently been published, one by Mr. S. O. Ridley of the British Museum of Natural History,[2] and the other by Professor Duncan.[3] It seems to be clearly established that budding takes place from the *walls* of the calicles, and not from their *margin*. No case of marginal budding or fission has come under my observation.

Fifty species of the genus are in the collection. Of these it is probable that some will have to be made synonyms of others, for though, from the want of series of specimens, it has been impossible in many cases to determine with certainty their specific identity or difference, it is evident that many of the forms are very closely allied.

1. *Madrepora securis*, Dana.

Madrepora securis, Dana, Zoophytes, p. 486, pl. xliii. fig. 2.

Three large fragments of this species were obtained. One, from Banda, is simply an erect plate, grown obliquely on one side, the upper margin of which has lost its typical quadrate shape and become somewhat trenchant. The calicles, though tubiform, have the lower edge much stronger than the upper, and often become rather shortly cochleariform, as in *Madrepora labrosa*.

Localities.—Banda; Samboangan, Philippines.

2. *Madrepora cuneata*, Dana.

Madrepora cuneata, Dana, Zoophytes, p. 487.

A single small specimen and a fragment of this species were obtained. The thick lobes which arise from the spreading, incrusting, recurved and contorted plates, are very

[1] *Proc. Amer. Assoc. Adv. Sci.*, 1867, p. 150.
[2] *Ann. and Mag. Nat. Hist.*, ser. 5, vol. xiii. p. 284.
[3] *Ann. and Mag. Nat. Hist.*, ser. 5, vol. xiv. p. 188.

short and irregular, and indicate the characteristic shape of the species as described by Dana.

Locality.—Reefs, Fiji.

3. *Madrepora palmata*, Lamarck.

Madrepora palmata, Lamarck, Hist. Anim. sans Vert., ii. p. 278, 1816.

As pointed out by Pourtalès [1] from actual observation on the Florida reefs of a large number of specimens, of all sizes and ages, *Madrepora flabellum*, Lamarck, *Madrepora alces*, Dana, *Madrepora cornuta*, Duchassaing and Michelotti, and *Madrepora thomasiana*, Duchassaing and Michelotti, are but varieties of this species, and "pass from one to the other by gradations among which it is impossible to draw the limit." A series of specimens in the collection fully bears out this conclusion.

Locality.—St. Thomas, West Indies.

4. *Madrepora prolifera*, Lamarck.

Madrepora prolifera, Lamarck, Hist. Anim. sans Vert., ii. p. 281, 1816.

A single specimen of this species was obtained. It is very close to *Madrepora cervicornis*, and bears out the remark of Pourtalès as to the doubtfulness of their specific difference.[2]

The figure in the Report on the Florida Reefs, pl. xix., can scarcely be considered typical of the species, since it presents a form with the thick, short calicles which are more generally characteristic of *Madrepora cervicornis*. The calicles in this species are generally very long, tubular, and rather slender, especially towards the distal parts.

Madrepora ethica, Duchassaing and Michelotti, does not seem to be separable from this species.

Locality.—St. Thomas, West Indies.

5. *Madrepora cervicornis*, Lamarck.

Madrepora cervicornis, Lamarck, Hist. Anim. sans Vert., ii. p. 281, 1816.

A fine example of this species was obtained. The form, size, length, and striation of the calicles are very variable in the species; and the variable thickness of the corallum in a series of specimens is a marked feature.

A very good figure of the species is given in the Report on the Florida Reefs, pl. xviii.

Locality.—St. Thomas, West Indies.

[1] *Illus. Cat. Mus. Comp. Zoöl.*, No. iv. p. 83.

[2] *Illus. Cat. Mus. Comp. Zoöl.*, No. iv. p. 84.

6. *Madrepora manni*, n. sp. (Pl. IX. figs. 1–1*a*).

Corallum arborescent and loosely branched, somewhat prostrate; the branches round, much elongated, about 2 cm. thick or more, gradually diminishing, and with few branchlets; branchlets simple, very elongated, often as much as 9 cm. long, slightly tapering, about 15 mm. thick at the base and 6 mm. at the apex, ascending, arcuate, irregularly bent and generally springing from the upper surface of the oblique branches. Apical calicles not large, from 2 to 3 mm. wide, not prominent, with rather thick and scarcely porous edges; star somewhat distinct, with six or twelve unequal, narrow septa. Lateral calicles extremely and broadly labellate, at right angles to the branch, very crowded; fragile, so that the lips are easily broken away, leaving the stronger basal part; more abundant, more prominent and stronger on the upper surface, becoming short and immersed on the basal part; the lip seldom flattened, generally curved, thin, and about 2·5 mm. long, often as broad, though generally narrower and sometimes very small. A section of the cell across the base of the lip shows a very narrow aperture, about 0·5 to 1 mm. wide, the immersed cells being of the same width; star inconspicuous. The cœnenchyma close and dense; the surface finely granulated and echinulated, and the calicles strongly striated.

This form in its strongly marked characters differs from all other known species of the genus. It is named in honour of Dr. de Mann, late of the Leyden Museum, who first recognised its specific distinctness, but did not describe it. Its representative in the collection consists of a branched portion evidently broken from a large specimen.

Locality.—Samboangan, Philippines.

7. *Madrepora nobilis*, Dana.

Madrepora nobilis et secunda, Dana, Zoophytes, p. 481, pl. xl. figs. 3, 4.

Only a much branched portion of a specimen was obtained. It agrees closely with the form described by Dana as *Madrepora secunda*; but Verrill has stated that intermediate forms between this and *Madrepora nobilis*, which have been examined by him, show that they are one and the same species. In accordance with this observation of Verrill's I have united the two species, though to judge by the description and figures given by Dana, they seem clearly distinct.

Locality.—Kandavu, Fiji.

8. *Madrepora canalis*, n. sp. (Pl. IX. figs. 2–2*b*).

Corallum arborescent, large, erect, loosely branched; branches few, three or four often springing from the main stem at the same level, terete, about 2 cm. thick or more,

gradually diminishing to a blunt end, which is often crowned by two or three branchlets; angle of branching acute; branchlets narrowly subconical. Terminal calicles rather large, from 3 to 4 mm. wide, not prominent, with much thickened edges; star very distinct, with six large and six small septa. Lateral calicles large, crowded, erect, broadly dimidiate or spout-shaped, presenting a more or less crescentic outer margin, which is very thick and porous and very much broader than the basal part of the cup; star very distinct, of twelve well-developed septa, two of which are very large; length of calicles about 3 mm., often less, width at the margin as much; many calicles are quite small and are interspersed among the prominent ones, and on the under surface of the branches all the cells become smaller and shorter. Cœnenchyma reticulated and more or less porous; surface reticulate and echinulate, becoming striated on the cups.

This species is readily recognised by the characters of its calicles, which give a very striking appearance to the corallum. As the result of the narrowing of the basal part of the cups, where they join the branches, the aperture of the cell into the branch is very small. Only a single large specimen was obtained. Its closest ally seems to be *Madrepora nobilis*.

Locality.—Samboangan, Philippines.

9. *Madrepora robusta*, Dana.

Madrepora robusta, Dana, Zoophytes, p. 475, pl. xxxix. fig. 3.

Only two fragments of this species were obtained. The greater number of the branchlets taper much more gradually to a point than is shown in Dana's figures.

Localities.—Kandavu and other reefs, Fiji.

10. *Madrepora danæ*, Verrill.

Madrepora deformis, Dana (non Michelin), Zoophytes, p. 484, pl. xliii. fig. 1.
„ *danæ*, Verrill, Bull. Mus. Comp. Zoöl., Cambridge, U.S.A., vol. i. p. 41.

Two very fine specimens of this species were obtained. The description given by Dana requires amending in several particulars, for evidently it was founded on a rather small specimen. The chief branches are often simple, especially the shorter ones, but on attaining a height of about 10 cm. or more they become very proliferous at the apex, and often as many as nine small branchlets spring therefrom, while the basal portion is generally destitute of such branchlets, and is only crowded with the proliferous calicles which are found over the entire corallum, and which give it a very rough appearance. Although many of the thick branches are obtuse at the apex, yet very many taper almost to a point, as is shown in many parts of Dana's own figure; and the small branchlets are generally rapidly tapering. The lateral coalescence below of many of the large branches,

their irregularly bent and divergent forms, and the apical bunch of proliferous branchlets on the large specimens, give a peculiar appearance to the corallum. It closely resembles *Madrepora abrotanoides*, and may ultimately prove to be only a well-marked variety of that species.

Locality.—Tahiti.

11. *Madrepora austera*, Dana.

Madrepora austera, Dana, Zoophytes, p. 478.

The specimen of this species consists of a broad, low clump, which has evidently grown under peculiar conditions. The base has formed on one side a solid massive piece, while on the other sides it has grown incrusting over a mass of dead coral. The branches are short, thick, and very proliferous, and many of them have been broken during growth. The surface is very rough, reticulated and echinulate. The lateral calicles are harshly striated, frequently dimidiate, or tubo-nariform, with a very elongated aperture, very unequal, often proliferous, and becoming immersed on the basal parts of the branches and on the incrusting base. On the upper parts of the branches and branchlets immersed cells do not occur as numerously as in *Madrepora abrotanoides*, but they are often present in large numbers on the under side.

Locality.—Mactan Island, Philippines.

12. *Madrepora scabrosa*, n. sp. (Pl. X. figs. 2–2*e*).

Corallum fruticose, much branched, closely crowded, and proliferous, attaining a very large size; the branches subterete, thick at the base, often as much so as 3 cm., ascending, arcuate or irregularly bent, but not divaricate; branchlets subattenuate, often much elongated, but generally short, especially at the exterior basal part, where they are thick, irregular, and almost spike-shaped. Apical calicles about 3 mm. wide, prominent, with thick, somewhat porous edges, and a distinct star of twelve unequal, narrow septa, which meet deep down in the cell. Lateral calicles rather appressed, very unequal, often 5 mm. long; scarcely crowded above, where they are tubiform and long, quickly becoming tubo-nariform and rostrato-nariform; crowded below, short, rostrato-nariform, and round-nariform, rarely proliferous, and almost or completely immersed on the basal parts; many very short and small cells occur between the prominent ones, opening sideways or downwards; and numerous, long, tubiform cells on the upper branches and branchlets become proliferous with short calicles along their under side, remaining bare on their upper side during a long period of growth; the aperture of the cell is large, round below and oblong above, with the lower side very rough and generally finely spinulose; star

distinct, of twelve narrow, unequal septa, which meet low down in the cell. Cœnenchyma very dense; surface closely and strongly echinulate throughout, but not striated even on the cups.

A single large specimen of this well-marked species was obtained. Its closest ally seems to be *Madrepora divaricata*, Dana, from which, however, it is easily distinguished.

Locality.—Levuka, Fiji.

13. *Madrepora plantaginea*, Lamarck.

Madrepora plantaginea, Lamarck, Hist. Anim. sans Vert., ii. p. 279, 1816.
" " Milne-Edwards and Haime, Cor., iii. p. 149.

A single specimen of this species was obtained. The apical cups are about 3 mm. or more in diameter. In the type-specimens of Lamarck, one of which has been redescribed by Milne-Edwards and Haime, the apical cups of many of the larger branches are very abnormally thickened, varying from 5 to 8 mm. in width, and are very short, with a broad rosette of small lateral calicles around them, evidently brought about by the stoppage of vertical growth and the increase horizontally under unfavourable conditions.

Madrepora acervata, Dana, referred by Verrill to this species, seems to be distinct from it.

Locality.—Tahiti.

14. *Madrepora cerealis*, Dana.

Madrepora cerealis, Dana, Zoophytes, p. 460, pl. xxxv. fig. 2.

A fine specimen of this species was obtained. It has grown in an oblique manner, forming a spreading cespitose clump, springing from the end of a long, nearly horizontal stump. The lateral calicles are often 4 mm. long, the proliferous ones being even more, and are tubo-nariform, rostrato-nariform, or even dimidiate; their exterior is finely and closely striated.

Locality.—Amboina.

15. *Madrepora retusa*, Dana.

Madrepora retusa, Dana, Zoophytes, p. 462.

A small specimen of this species was obtained. It consists of two erect branches bearing a few branchlets above. The immersed calicles interspersed among the prominent ones are very small.

Locality.—Tahiti.

16. *Madrepora nasuta*, Dana.

Madrepora nasuta, Dana, Zoophytes, p. 453, pl. xxxiv. fig. 2.

Two very interesting specimens of this species were collected. In one, the calicles are strikingly prominent above, never appressed, quickly obsolescent at a short distance from the apex, and almost entirely immersed below so that the aperture is directed more outward than upward from the branchlets; in the other, the calicles are less prominent, rather appressed, and obsolescent at a greater distance from the apex than in the former specimen. In both, many of the branchlets are frequently divided and often proliferous above.

Locality.—Tahiti.

17. *Madrepora effusa*, Dana.

Madrepora effusa, Dana, Zoophytes, p. 455.

The specimen of this species is a broad, cespitose, and one-sided clump, which has spread over dead coral, its growth having evidently taken place under unfavourable conditions. As a result of this disturbance the basal disk is very slightly developed, and the spreading branches are rather loosely coalescent. The lateral calicles are prominent, very irregular in size and shape, being either long or short, compressed-nariform, tubo-nariform, or dimidiate.

Locality.—Amboina.

18. *Madrepora paxilligera*, Dana.

Madrepora paxilligera, Dana, Zoophytes, p. 452, pl. xxxiv. fig. 1.

A large specimen of this species was obtained. It consists of numerous, closely-crowded branchlets arising from a large, solid base, which is nearly flattened below and attached by a small pedicel, and from which numerous, closely-placed, very flattened, coalescent, divided branches spread horizontally. The vertical branchlets often arise two or three together, rarely more, and are seldom divided at the apex. The lateral calicles are rather large, very crowded, dimidiate or tubo-nariform, a little prominent and somewhat appressed; not immersed below, except at the extreme basal parts of the branchlets, but becoming appressed, rounded, somewhat swollen, with the aperture opening upwards and distinctly seen from above.

The species seems to be very close to *Madrepora nasuta*, and may ultimately have to be united with it.

Locality.—Tahiti.

19. *Madrepora seriata* (Ehrenberg).

Heteropora seriata, Ehrenberg, Cor. roth. Meer., p. 113.

A single specimen of this species was obtained. It forms a broad, spreading tuft, incrusting a mass of dead coral. The lateral calicles are wide, open, generally tubular or subtubular, sometimes cochleariform, with a much thickened lower portion; they are closely placed, and arranged in well-marked rows up the branches and branchlets, especially towards the apical parts; many immersed calicles occur between the prominent ones, and towards the basal parts all the cups are shortly verruciform and much thickened, becoming immersed and often obsolescent. The central branches are somewhat compressed and angular, nearly simple or marked with many large calicles giving origin to branchlets; the exterior stems are shortly and much branched.

Madrepora pyramidalis, Klunzinger, seems to be extremely close to this species.

Locality.—Kandavu, Fiji.

20. *Madrepora hebes*, Dana.

Madrepora hebes, Dana, Zoophytes, p. 468, pl. xxxv. fig. 5.

Three specimens of this species were obtained. One small specimen presents many points of divergence from the common form; the lateral calicles are larger, sometimes as much as 3 mm. wide, and more gaping; the branches are thicker and shorter, and crowned above by a stouter apical calicle. This form seems to be that described and figured by Quoy and Gaimard as *Madrepora pocillifera*.[1]

Localities.—Kandavu and other reefs, Fiji.

21. *Madrepora pocillifera*, Lamarck.

Madrepora pocillifera, Lamarck, Hist. Anim. sans Vert., ii. p. 280, 1816.
" " Milne-Edwards and Haime, Cor., iii. p. 141.

The branches and branchlets of the specimens vary considerably in length and thickness. In some they are short and uniformly thick almost to the tips, where they become slightly acuminate; in others they are elongated, and lessen gradually in size, becoming much more pointed at the ends. The apical calicles consequently are large and thick, or rather delicate and small.

The tufted and thick growth of *Madrepora pallida*, Klunzinger, and its thick, open, tubular, lateral calicles separate it easily from this species in which the calicles are rather thin and fragile, cochleariform or short-labellate.

The lower portion of the corallum with its rough, uneven surface and rather large, immersed cells bears some slight superficial resemblance to a *Pocillopora*.

Localities.—Reefs, Fiji; Api, New Hebrides; Tongatabu.

[1] Voy. de l'Astrolabe (Zool.), vol. iv. p. 236, pl. xix. fig. 5.

22. *Madrepora laxa*, Lamarck.

Madrepora laxa, Lamarck, Hist. Anim. sans Vert., ii. p. 280, 1816.
„ „ Milne-Edwards and Haime, Cor., iii. p. 146.

A portion only of a specimen was obtained. The species is very close to *Madrepora pocillifera*, but seems to be sufficiently distinguished by the nature of the calicles, which are tubo-labellate, much thicker and stronger, especially on the under side of the cup, not oblique or fragile, but becoming verruciform, especially towards the basal parts of the branchlets. The branches are often short and thick, with many proliferous branchlets crowned by thick and broad apical cups. The surface is shortly striate, dense and echinulate.

Locality.—Reefs, Fiji.

23. *Madrepora aspera*, Dana.

Madrepora aspera, Dana, Zoophytes, p. 468, pl. xxxviii. fig. 1.

The specimens of this species agree closely in essential features with the description given by Dana, whose specimen was a fragment 3 inches in height. Those in the collection are large and much branched specimens, and show very clearly that though the apical parts are porous in texture, the basal portions are dense and firm. The lateral calicles are very unequal and rather crowded, many very small narrow labellate ones being placed between the larger, which are broadly labellate; the aperture of the cell where it joins the branch is always small. Dana characterises the cells as being quite large, but a reference to his figure of a branch, natural size, will show that the term must be applied to the broad lip and not to the aperture of the cell where it joins the branch. His measurement for the width of the immersed cells below is half a line, but at the basal parts in large specimens it is much smaller, and in many parts the cells are seen to be quite minute openings over the surface of the corallum.

The fragile lips of the lateral calicles, which are very prominent above and erect or divaricate, are very easily destroyed, the narrow cells becoming more or less obsolescent; while the stronger basal parts of the larger calicles give a rough and ragged appearance to the branches.

The species is very close both to *Madrepora pocillifera* and to *Madrepora laxa*. In *Madrepora pocillifera* the calicles are quite oblique, more open and cochleariform, larger and more crowded; in *Madrepora laxa* the differences seem to be less marked, but the calicles are shorter, not fragile, tubo-labellate with a thickened lip which is not flattened, but almost verruciform in many parts.

Locality.—Mactan Island, Philippines.

24. *Madrepora millepora* (Ehrenberg.)

Heteropora millepora, Ehrenberg, Cor. roth. Meer., p. 109.
Madrepora millepora, Dana, Zoophytes, p. 446, pl. xxxiii. fig. 2.

Only a single specimen of this species was obtained. It has grown with an incrusting base over a mass of dead coral, and is made up of a mass of closely crowded, young colonies in different stages of growth; some with simple stems, others forming small and much branched clumps; while in other places, on the incrusting base, there are numerous, large, apical calicles, from which new branches originate. The calicles on the branches and branchlets are about 1 mm. broad, but they are usually much smaller on the base.

Locality.—Api, New Hebrides.

25. *Madrepora minima*, n. sp. (Pl. IX. figs. 4–4*a*).

Corallum arborescent, spreading-ramose, very slender; often slightly compressed and incrusting dead coral where it comes in contact with it; branches rather short, terete, bluntly pointed, from about 4 to 6 mm. thick, with few, short, scarcely smaller branchlets; not infrequently the branches on meeting a foreign body spread over it and become broad and thickened. Apical calicles moderately large, nearly 3 mm. in diameter, scarcely prominent with six large and six small well-developed septa. Lateral calicles very small, unequal, and crowded, from about 0·5 to 0·75 mm. in diameter, scarcely prominent, quite immersed below, fragile, strongly striated, round-nariform or sublabellate; six septa distinct, with two larger than the others, the second cycle rudimentary. The surface is finely echinulate, of a close texture below, becoming somewhat porous above.

This species is close to *Madrepora exigua*, Dana, but is easily distinguished from it. Two small specimens about 9 cm. high were obtained, and many of the branches have a peculiar appearance, spreading over and incrusting pieces of dead coral.

Locality.—Api, New Hebrides.

26. *Madrepora tenuis*, Dana.

Madrepora tenuis, Dana, Zoophytes, p. 451.

Numerous specimens of this species were obtained. The branchlets are very numerous and slender, but are often as much as 5 or 6 mm. thick at their base.

Locality.—Samboangan, Philippines.

27. *Madrepora rosacea*, Esper.

Madrepora rosacea, Esper, Pflanz., i., Madrep. pl. xv.
" " Studer, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, 1878, p. 530.

Three specimens were obtained, of which one forms a cespitose clump with close branches, subdividing into numerous branchlets above. The calicles are narrow but very

long, appressed, tubiform, tubo-nariform, or shortly labellate, very strongly striated; on the basal parts they become shortly verruciform and immersed. Many short or immersed cells occur between the prominent ones. The branches may be short or much elongated, and give a corresponding appearance to the clump. The surface is striate and finely echinulate.

Localities.—Ternate; Samboangan, Philippines.

28. *Madrepora pustulosa*, Milne-Edwards and Haime.

Madrepora pustulosa, Milne-Edwards and Haime, Cor., iii. p. 144.

A small specimen was obtained which differs from typical specimens of the species in a few particulars, but not sufficiently to separate it.

The branches are rather numerous, not notably thick below, and they decrease gradually in size to the point of origin of the branchlets. Many small, irregular calicles are interspersed among the long, tubular ones above; and below, on the basal parts, the calicles become short, swollen and uneven, often obsolescent, especially on one side of the corallum, which has evidently been the under side.

A new species from the Red Sea, quite different from this, has been described by Klunzinger under this name; and as Milne-Edwards and Haime claim priority for the term *pustulosa*, I propose to associate the name of the distinguished author with the species—*Madrepora klunzingeri* = *Madrepora pustulosa*, Klunzinger.[1]

Locality.—Levuka, Fiji.

29. *Madrepora gracilis*, Dana.

Madrepora gracilis, Dana, Zoophytes, p. 482, pl. xli. fig. 3.

Two fine specimens and a few fragments were obtained. The lateral calicles are very obliquely placed, and on the branchlets are often much elongated (3 mm.) and tubo-nariform, while on the basal parts they become quite short.

Locality.—Amboina.

30. *Madrepora virgata*, Dana.

Madrepora virgata, Dana, Zoophytes, p. 471, pl. xxxix. fig. 1.

Small specimens were obtained, many of the branches of which are rather thinner than in those described by Dana, and are more frequently divided.

Locality.—Tahiti.

[1] Cor. roth. Meer., ii. p. 8, pl. i. fig. 1.

31. *Madrepora ramiculosa*, Dana.

Madrepora ramiculosa, Dana, Zoophytes, p. 463, pl. xxxv. fig. 4.

A single small specimen was collected. It forms a dense, closely-branched, convex clump, about 6 cm. high. It is evidently only a young specimen.

Locality.—Reefs, Fiji.

32. *Madrepora confraga*, n. sp. (Pl. IX. fig. 6–6*a*).

Corallum spreading, prostrate, flattened, or vasiform (?), consisting of somewhat vertically compressed, very uneven, seldom coalescent branches, which are much divided into numerous, widely-placed clusters of very irregular and rough-looking, divided branchlets. The branches are about 15 mm. thick or more, angular, rapidly diminishing in size as they divide; the branchlets on the upper part of the corallum are short and rather thick, about 7 mm. wide at their base, rapidly lessening in size; on the under side of the corallum the branchlets are less divided and more spike-like. The apical calicles are rather prominent and small, from about 2 to 2·5 mm. wide, with rather thick edges and a distinct star of six large and six very small septa. Lateral calicles short, about the same size as the terminal ones, not at all crowded, generally much swollen and subglobose, with an aperture of about 1 mm., opening upwards; on the basal parts of the branches and on the under surface the cells become immersed and more scattered; star very distinct, of six large and six very small septa. Cœnenchyma very dense throughout; surface slightly reticulate, and very irregularly and echinulately striated.

A single large piece of a specimen of this species was obtained, and evidently from the nature of the branches spreading horizontally in the same plane it must have grown in a prostrate manner, flattened or vasiform.

The species bears a close resemblance in many of its characters to *Madrepora ramiculosa*, Dana, but its mode of growth, the nature of its calicles, and the nature of the cœnenchyma at once distinguish it.

Locality.—Kandavu, Fiji, brought up in the trammels at the anchorage.

33. *Madrepora mirabilis*, n. sp. (Pl. X. fig. 5–5*b*).

Corallum prostrate; the branches originating laterally from a thick, compressed, elongated stem, and somewhat coalescent with one another. The stem may be 4 cm. wide, or more, tapering gradually; often spreading over masses of dead coral, but not forming a thick basal disk. The under part of the prostrate stem and branches almost entirely destitute of branchlets, but on the upper part and on the sides the branches are very numerous and closely placed. They are short, spike-shaped, and simple, from about 6 to 7 mm. thick at the base, and rarely divided above. The apical calicles are moderately large,

generally about 2·5 mm. wide, sometimes more, very short and thick, with very porous edges, and with a very distinct star of twelve septa. In many apical cups small or rudimentary septa of athird cycle are present, and in a few cups of larger size they are large and well developed. The lateral calicles are very unequal and variable, generally about 1·5 mm. wide, immersed and rather widely placed on the under surface and over a large part of the upper surface; often slightly prominent on one side, forming very short, open, round-nariform cups, while not infrequently they are crowded, and, by the thickening and upgrowth of the under side, shortly verruciform. The stars are very distinct, of twelve unequal septa; and in those calicles which are not verruciform, two opposite septa of the first cycle become decidedly and strongly exsert. The cœnenchyma is porous in the younger parts, becoming closely reticulate and dense below; the surface very roughly and closely echinulate, and strongly striated on the under sides of the calicles.

A single specimen of this species was obtained. It has grown prostrate in one direction to a length of about 26 cm., branching laterally and so closely that the branches are broadly coalescent at the point of origin. Many parts of it are dead, and more or less incrusted by fresh growth. Its peculiar characters separate it widely from all other known species of the genus.

Locality.—Banda.

34. *Madrepora aculeus*, Dana.

Madrepora aculeus, Dana, Zoophytes, p. 450, pl. xxxii. fig. 6.

A small, dead, and somewhat incrusted fragment of a corallum has been doubtfully referred to this species. It differs from Dana's figure chiefly in the nature of the branchlets, which are here shorter and furcate, sometimes divided into three or four, with a thick base from about 7 to 9 mm. in diameter. In other essential characters it agrees with the species.

Locality.—Samboangan, Philippines.

35. *Madrepora angulata*, n. sp. (Pl. IX. figs. 5–5*a*).

Corallum arborescent and rather sparsely branched, somewhat prostrate; the main stem elongated, subterete, or slightly and irregularly compressed, or twisted and acutely angular, of nearly uniform size throughout, from about 6 to 8 mm. wide, somewhat wider at its upper part where the main branches originate. The branches and chief branchlets are but slightly smaller than the main stem, rather short and angular, not coalescent; the young branchlets much smaller and tapering; they develop chiefly on opposite sides of the stem at an angle of about 50°, but many are found placed quite irregularly. Apical calicles not large, scarcely prominent, about 2 mm. wide, sometimes more, with thin edges which are not porous; star distinct, of six large, unequal septa, and six small

and sometimes rudimentary ones. Lateral calicles somewhat smaller, nearly 2 mm. wide, unequal, from 1·5 to 5 mm. long, subseriate, tubo-nariform and rostrato-nariform, not crowded; often rather widely placed, appressed, round-nariform and very short, especially on the basal parts of the stem and chief branches; star distinct, of six large septa, others smaller and rudimentary, two of the opposite, large septa generally united together almost to the very aperture. Cœnenchyma reticulated and dense; surface throughout finely or strongly costulated and echinulated.

This well-marked species is represented by a single specimen about 17 cm. high.

Locality.—Samboangan, Philippines.

36. *Madrepora diffusa*, Verrill.

Madrepora diffusa, Verrill, Bull. Mus. Comp. Zoöl., Cambridge, U.S.A., vol. i. p. 41.

The specimen consists of an arborescent trunk, the larger branches of which are spreading, much divided, and rather prostrate. On the small branches and branchlets the texture of the corallum becomes very light and open, though firm; while the costæ become scarcely spinulose, and are more distinctly lamellate than on the basal parts.

Locality.—Banda.

37. *Madrepora tubigera*, Horn.

Madrepora tubigera, Horn, Proc. Acad. Nat. Sci. Philad., 1860, p. 435.

A fine specimen of this species was obtained. It consists of a much divided, prostrate stem, from which branches and branchlets arise to very different heights. Some of the branches are much subdivided and form a dense clump. The whole corallum is very porous; the calicles are large and open, and on the stem and chief branches they become immersed.

Locality.—Banda.

38. *Madrepora capillaris*, Klunzinger.

Madrepora capillaris, Klunzinger, Cor. roth. Meer., ii. p. 29, pl. iii. fig. 4.

Several fragments were obtained. The cups are often much smaller than those in Klunzinger's specimen, fragile and labellate or dimidiate. It bears a general resemblance to a small and delicate variety of *Madrepora tubigera*, but differs in the nature of the calicles and of the surface, and in the thickness of the branches.

Locality.—Banda.

39. *Madrepora echinata*, Dana.

Madrepora echinata, Dana, Zoophytes, p. 464, pl. xxxvi. fig. 1.

Two small specimens were collected. One has grown almost entirely in a horizontal direction, and thus has the calicles of the under surface much shortened or suppressed; the other is more erect. They more closely resemble the figure given by Milne-Edwards and Haime[1] than they do that given by Dana.

Locality.—Reefs, Fiji.

40. *Madrepora rosaria*, Dana.

Madrepora rosaria, Dana, Zoophytes, p. 465, pl. xxxvi. fig. 3.

Two very beautiful specimens referable to this species are in the collection. The measurements throughout are rather less than those given by Dana; and the specimens are thus examples of a rather delicate variety. A few of the branchlets are very spreading and elongated, producing new branchlets by their subdivision, and tending to give to the whole clump an uneven appearance.

Locality.—Levuka, Fiji.

41. *Madrepora parilis*, n. sp. (Pl. IX. figs. 3–3*b*).

Corallum spreading more or less horizontally; the branches and branchlets developing continuously in one plane from opposite sides of the larger branches, and of nearly equal size throughout, from about 5 to 7 mm. thick; the younger branchlets short and somewhat smaller. The branches are subterete or horizontally compressed, sometimes subangular, closely placed, and very rarely coalescent. The angle of branching is nearly a right angle. The apical calicles are rather large, from about 2 to 3 mm. wide, a little prominent, with thick and porous edges, and with a distinct star of twelve septa, of which six are rather large and unequal. The lateral calicles are wide apart, tubular, rather large, prominent, and not appressed, unequal, very sparse on the under side, where, when the branches are much compressed, they are almost absent, though forming series along the edges; they are from 1 to 2 mm. in diameter, and from 1 to 4 mm. long; others still longer give rise to branchlets. The star is quite distinct, of six large septa, with others generally more or less rudimentary. Cœnenchyma rather light and porous; surface throughout very strongly and distinctly striated or costulated with fine echinulations, which are even more marked on the calicles where the striations usually become very closely placed and thin.

This species has many points of resemblance with the *Madrepora pumila*, Verrill, but it is easily distinguished from it. Several pieces occur in the collection.

Locality.—Samboangan, Philippines, 10 fathoms; Tahiti (?).

[1] Cor., pl. E 1, fig. 4.

42. *Madrepora secale*, Studer.

Madrepora plantaginea, Dana (*non* Lamarck), Zoophytes, p. 459.
Madrepora secale, Studer, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, 1878, p. 530.

The specimens described by Dana as *Madrepora plantaginea*, Lamarck, have been referred by Verrill to *Madrepora appressa*, var.; but Studer has described it as a distinct species under the above name. A small specimen is in the collection, and its characters tend to prove that Studer's conclusion is the right one. As stated by Dana, the species may be distinguished from *Madrepora appressa* (Ehrenberg), by its calicles, which are rather stout, tubiform or very slightly compressed, often dimidiate, very unequal and but slightly appressed.

Locality.—Ternate.

43. *Madrepora appressa* (Ehrenberg).

Heteropora appressa, Ehrenberg, Cor. roth. Meer., p. 109.
Madrepora appressa, Dana, Zoophytes, p. 459, pl. xxxiv. fig. 3.

A single specimen in the collection measures nearly 1 foot in diameter, and is of rather stout growth. It has evidently grown from a central, basal attachment, but the colony has developed almost entirely in one direction as though from a lateral attachment. The branchlets are often grouped two or three together, and are united at the basal parts. At the outer part of the corallum these branchlets are shorter, much more thickened and more divided, with rather short, thickened, and less imbricated calicles.

Locality.—Amboina.

44. *Madrepora prostrata*, Dana.

Madrepora prostrata, Dana, Zoophytes, p. 447, pl. xxxiii. fig. 1.

The specimen which has been referred to this species consists of a small, prostrate branch, with many small, obliquely ascending branchlets. It seems to have been broken from the outer part of a dead clump. The calicles are broadly labellate, passing into the dimidiate form, unequal and often thickened at the base, this portion remaining rather prominent when the lip is rubbed away.

Locality.—Samboangan, Philippines.

45. *Madrepora speciosa*, n. sp. (Pl. X. figs. 1–1*b*).

Corallum shortly and narrowly pedicellate, spreading horizontally or slightly concave above; consisting of much divided and much compressed branches, from about 9 to

10 mm. wide and 4 to 5 mm. thick, which are coalescent so as to form a broad and thin lamina with numerous meshes. The under side, where the flattened, coalescent branches and branchlets are seen to form an irregular trellis-work with meshes of different sizes and shapes, is almost entirely destitute of calicles, except a few immersed ones; some large and long calicles occur, which spring from the compressed edges of the branches and give rise to small branchlets, which become closely appressed to, and ultimately fuse with, the adjacent branches. The upper side is covered throughout with closely placed clusters of very long, proliferous calicles, which are sometimes in groups of five or six, and between which occur a few shorter and immersed ones. The calicles of the clusters are tubiform, about 15 mm. long (often more or less), curved, tapering and irregularly bent, from about 3 to 4 mm. wide at their base and 1·5 mm. at their apex, and many of them carry two or three short and small, lateral calicles. At the outer, free edges of the corallum the branches are not elongated, but short and rather thick, and the calicles are short and thick proportionately and more closely placed, but never crowded. Six septa are present, and sometimes there are rudiments of a second cycle. The cœnenchyma is dense, and the surface very closely and finely echinulate. In many places, and chiefly between the coalescent branches, the surface becomes reticulate or finely fissured, so as to present a worm-eaten aspect.

In its mode of growth this species bears marked resemblance to *Madrepora granulosa*, Milne-Edwards and Haime, but its other characters easily distinguish it. A large specimen and a few fragments were obtained.

Locality.—Tahiti.

46. *Madrepora hyacinthus*, Dana.

Madrepora hyacinthus, Dana, Zoophytes, p. 444, pl. xxxii. fig. 2.

A single very large, shallow, vasiform specimen, about 40 cm. in diameter, is in the collection, and it agrees in every particular with the excellent description given by Dana. The branches are frequently, though loosely, coalescent; and often towards the centre of the vase the branchlets become very short and proliferous. The vase is very irregular in outline, owing to the unequally grown branches. The apical calicles are very uniform in size, from 2·5 to 3 mm. in diameter.

Locality.—Levuka, Fiji.

47. *Madrepora conferta*, n. sp. (Pl. X. figs. 3–3*c*).

Corallum flattened, about 2 to 3 cm. thick; branches very closely packed and much divided, densely and intricately coalescent, with narrow, elongated meshes, but with the main branches remaining distinguishable. On the under side there are numerous, coalescent

branchlets and proliferous calicles closely appressed into the plane of the frond, giving it a very rough appearance; at various parts they coalesce with the branches to form small, solid areas, in which all traces of the original forms are lost, and on which there are short, crowded, almost immersed calicles. Above, the branchlets are very short, from about 6 to 10 mm. long, rather thick (about 5 or 6 mm.) in comparison with their length, placed at right angles to the frond, obtuse and rosette-shaped at their apex, and proliferous; at the edges of the corallum they are somewhat longer and thinner. The terminal calicles are about 1·75 mm. wide, scarcely or not at all prominent, with rather thick edges and a distinct star of six septa. The lateral calicles are very small throughout, more conspicuously so at the base, rather broadly and curvedly labellate, very closely crowded, not appressed, generally erect, and with an inconspicuous star of six septa; at the apex they are gathered into a rosette of almost tubo-labellate cups around the short terminal calicle, often with a few larger proliferous ones. The rosette is much less distinct towards the outer parts of the frond. On the basal parts the calicles become quite immersed and are about 0·5 to 0·75 mm. wide. The cœnenchyma is rather dense, becoming porous and reticulate in the younger parts; the surface is echinulate and substriate, distinctly striate on the cups.

Of this species there occurs in the collection only a large, broken, flattened frond, which may have formed a portion of an irregularly grown, shallow-vasiform specimen.

Locality.—Reefs, Fiji.

48. *Madrepora cytherea*, Dana.

Madrepora cytherea, Dana, Zoophytes, p. 441, pl. xxxii. fig. 3.

Fine specimens of this species were obtained, one of which is nearly a yard in diameter and possesses a high pedicel. The branches though much flattened and coalescent are very distinct throughout, lessening gradually in size; the calicles are fragile and very long, especially the apical ones, which are often grouped in short and thick clusters. The cœnenchyma is quite light and porous in the younger parts.

Locality.—Tahiti.

49. *Madrepora vastula*, n. sp. (Pl. X. figs. 4 4*c*).

Corallum broadly and very deeply vasiform, somewhat roughly funnel-shaped and narrowly pedicellate; fronds about 4 cm. thick almost evenly to the edges; branches closely divided so as to be nearly subequal throughout, intimately coalescent even to the margin of the vase, evenly reticulated, with small, narrow meshes between them; the under side rough with numerous, appressed, coalescent branchlets, and unequal, proliferous calicles; the upper surface closely crowded with arcuate, tapering, elongated, subproliferous,

divided branchlets, which are generally evenly placed, from about 5 to 7 mm. thick, and 1 to 3 cm. long, except at the centre of the vase, where they are short and almost suppressed, and never developed with clusters of long, proliferous calicles. Terminal calicles 2 mm. wide, somewhat prominent, about 2 mm. long, with a distinct star of twelve subequal septa. Lateral calicles rather large, often nearly 3 mm. long, and from 1·5 to 2 mm. wide, crowded, labellate, with a scarcely flattened lip, somewhat fragile and rather closely placed at the apex around the terminal calicles; the basal calicles are very shortly labellate or subnariform, but many wide, immersed calicles are present; star with very narrow septa. Cœnenchyma rather dense, becoming reticulated on the distal parts; surface rough, irregularly echinulate and striate.

A single specimen of this species was obtained. It is close both to *Madrepora hyacinthus* and to *Madrepora cytherea*. The branches are very compressed vertically, much and evenly divided and coalescent, so as to form an evenly reticulated lower surface in which the main branches are indistinguishable. The even thickness of the frond gives a massive appearance to the species.

Locality.—Kandavu.

50. *Madrepora surculosa*, Dana.

Madrepora surculosa, Dana, Zoophytes, p. 445, pl. xxxii. figs. 4, 5.

Fine specimens of this species were obtained; and they show very clearly the great variability in the size and form of the branchlets, which may be short, thick, tapering quickly to a point and spike-shaped, or, in other specimens, thin and elongated.

Locality.—Tahiti.

Genus 2. *Turbinaria*, Oken.

Turbinaria, Oken, Lehrb. der Naturg., Zool., i. p. 67, 1815.
„ Milne-Edwards and Haime, Cor., iii. p. 164.
„ Duncan, Rev. Madrep., p. 184.

Seven species of this genus are in the collection.

1. *Turbinaria crater* (Pallas).

Madrepora crater, Pallas, Elench. Zooph., p. 332.
Turbinaria crater, Milne-Edwards and Haime, Cor., iii. p. 164.

Three interesting specimens of this species were collected. One, a small one, is broadly vasiform, with wavy edges and small and shallow calicles; a second is infundibuliform and contorted, with deeper and more prominent calicles; while the third is an

explanate portion, broken from a large irregular specimen much infested by parasites, having its calicles either low and shallow or rather prominent and deep.

The species is close to *Turbinaria cinerascens*, but the cups are smaller and shallower, less distinctly open, and with a smaller, oval columella. A good figure of a small specimen is given by Blainville.[1]

Localities.—Amboina; Somerset, Cape York, shore; Wednesday Island, Torres Strait, 8 fathoms.

2. *Turbinaria cinerascens* (Ellis and Solander).

Madrepora cinerascens, Ellis and Solander, Zoophytes, p. 157, pl. xliii.
Turbinaria cinerascens, Milne-Edwards and Haime, Cor., iii. p. 165.

Two small specimens, vasiform and slightly contorted, were collected. The species is close on the one hand to *Turbinaria crater*, and on the other to *Turbinaria mesenterina*, and it is doubtful, perhaps, whether it is really distinct from the latter species.

Locality.—Somerset, Cape York, shore.

3. *Turbinaria brassica* (Dana).

Gemmipora brassica, Dana, Zoophytes, p. 413, pl. xxix. fig. 1.

Two small specimens occur in the collection. The calicles are much less elongated than is shown in Dana's figure; and the general habit of the species is closely similar to that of *Turbinaria mesenterina*.

Locality.—Tongatabu.

4. *Turbinaria patula* (Dana).

Gemmipora patula, Dana, Zoophytes, p. 410.

Two specimens, one a very large and the other a small one, and a fragment, were collected. The large specimen presents an interesting variation, the edges of the calicles being very acute, the septa very narrow with the inner edges vertical and evenly prominent, and the surface roughened by coarse, sinuous striations; the upper surface is made knobby at certain parts by the lodgment of parasites, and through the development of calicles on these knobs an upright, branched growth is produced.

A dead specimen of a *Turbinaria*, from the same locality, much perforated by some boring animal, apparently belongs to this species.

Locality.—Wednesday Island, Torres Straits, 8 fathoms.

[1] Manuel d'Actinologie, pl. lvi. fig. 6.

5. *Turbinaria peltata* (Esper.)

Madrepora peltata, Esper, Pflanz. Forts., i. p. 27, Madrep. pl. xlii.
Turbinaria peltata, Milne-Edwards and Haime, Cor., iii. p. 165.

A small and very typical example of this exceedingly well-marked species was obtained.

The regularly cup-shaped form of the young specimens of this species soon becomes lost, owing to a central development of cœnenchyma which tends to fill up the cavity, while the edges of the colony become variously and irregularly contorted and plicate. By the coalescence of opposite folds, large and unequal, bifacial plates and branches are formed, which possess a uniform thickness throughout, and often attain to a very great height.

Locality.—Somerset, Cape York, shore.

6. *Turbinaria æqualis*, n. sp. (Pl. VII. figs. 3–3*a*).

Corallum consisting of narrow, rather thick plates, evenly covered on both sides with calicles. Calicles circular, not crowded, from 2 to 3 mm. apart, very small, having a diameter of from 1 to 1·5 mm.; superficial, the fossa being filled up with the septa, the proximal part of the wall not raised, the calicles being nearly even with the surface, having the opening directed upwards at right angles; septa generally from sixteen to twenty, often with a few rudimentary ones, thin, delicately spinulous, projecting quite to the centre and filling up the cavity. Columella very rudimentary, consisting of one or two papillæ, generally absent. Cœnenchyma dense; surface not striate nor echinulate, extremely granulated.

Only a fragment of a specimen of this species is in the collection. It is a narrow, twisted plate, having a basal thickness of 7 mm. It seems to have much the same habit as *Turbinaria bifrons*, Brüggemann, but differs in essential characters from that species. It is probable that in both species the bifacial development of the calicles is due to flexure and fusion of the fronds in the early stages of growth. In *Turbinaria bifrons* the proximal parts of the oblique cups are much thickened and raised; and the cups, though rather shallow, are not superficial, but present an open cavity filled up at the base by a well-developed columella.

Locality.—Wednesday Island, Torres Straits, 8 fathoms.

7. *Turbinaria stellulata* (Blainville).

Astreopora stellulata, Blainville, Man. d'Actin., p. 383, pl. lx. fig. A.

Corallum massive, with an evenly and finely porous surface; very heavy, the cœnenchyma being of a dense texture throughout, though much perforated. Calicles rather small,

about 2·5 mm. in diameter and 2 mm. in depth, from about 3 to 4 mm. apart, slightly prominent so as to form a raised margin, often a little higher on one side; many calicles scarcely or not at all raised above the general surface. Septa twenty-four, well developed, equal or subequal, often one or two very small or absent. Columella well developed, forming a conspicuous, central, trabeculate mass.

A specimen in the collection evidently belongs to this species, which is figured but not defined by Blainville as *Astreopora stellulata*, and is confounded by him and by Lamarck with *Madrepora stellulata*, Ellis and Solander. Blainville's figures are good, except that in the magnified calicles twenty septa are given instead of the normal number twenty-four. Dana, who accepts Blainville's name for the species, records it from the Fiji Islands and enumerates many of its characters; but as Milne-Edwards and Haime point out, it is really referable to *Turbinaria* and not to *Astreopora*.

Turbinaria parvistellata, Kent, is closely related to this species, being the only other recorded species of *Turbinaria* in which the corallum is massive.

Locality.—Reefs, Fiji.

Genus 3. *Astreopora*, Blainville.

Astreopora, Blainville, Dict. d. Sci. Nat., lx., p. 348, 1830.
„ Milne-Edwards and Haime, Cor., iii. p. 167.
„ Duncan, Rev. Madrep., p. 185.

A single species of this genus is in the collection.

Astreopora profunda, Verrill.

Astreopora pulvinaria, Dana (*non* Lamarck), Zoophytes, p. 415, pl. xxix. fig. 3.
„ *profunda*, Verrill, in Dana, Cor. and Cor. Islands, p. 333.

A subglobular specimen occurs. The calicles are crowded or distant, quite immersed or raised conically, being often as much as 6 mm. high. The surface is roughly, raggedly, and closely echinulate. A very striking appearance is given to the species by the numerous irregularly placed, large and swollen, prominent calicles, which may be isolated or grouped in masses, with or without immersed calicles between them.

Locality.—Banda.

Genus 4. *Anacropora*, Ridley.

Anacropora, Ridley, Ann. and Mag. Nat. Hist., vol. xiii., 1884, p. 287.
„ Duncan, Rev. Madrep., p. 192.

Of this extremely interesting genus, recently described by Mr. S. O. Ridley of the British Museum [of Natural History], two species are in the collection. The only other

species of the genus at present known is the typical species *Anacropora forbesi*, Ridley, which was obtained at the Keeling Islands by Mr. H. O. Forbes.

1. *Anacropora gracilis*, n. sp. (Pl. X. figs. 6–6*c*).

Corallum small, fruticose, much branched, very porous throughout, light and fragile. Branches very coalescent, of nearly equal size throughout, about 4 mm. thick, often less, regularly dichotomous, with a widely opened angle, sometimes divaricate; branchlets of nearly the same thickness as the branches, short, rounded at the ends, and very easily broken away. Calicles very delicate and much raised, about 1 mm. high, subseriate, about 2·5 mm. apart, often much less, round and open nariform, slightly swollen, about 1·25 mm. wide, with a comparatively large aperture. Septa twelve, unequal, two of the primaries rather large. Cœnenchyma extremely loose and porous throughout; surface very finely, closely, and strongly echinulate, especially on the edge of the calicles, harsh to the touch.

This is a much more delicate and fragile species than *Anacropora forbesi*, Ridley. It is smaller and thinner throughout, much more coalescent, with a much harsher and more finely spinulose surface; it is strikingly porous and is destitute of any superficial layer of dense tissue. The calicles are very easily abraded by the touch, and will generally be found to be very slightly prominent on that account in specimens which have been much handled. The clump is about 6 cm. high, and rather more in width.

Locality.—Banda.

2. *Anacropora solida*, n. sp. (Pl. X. figs. 7–7*a*).

Corallum arborescent and slightly ramose, dense, not fragile. Branches originating irregularly at an open angle, sometimes divaricate, somewhat elongated, from about 6 to 7 mm. thick; branchlets thinner, strong, tapering, subacute, rather long, sometimes nearly 2 cm. in length. Calicles very small, slightly raised, round nariform, seriate or subseriate, about 2·5 mm. apart. Septa twelve, six larger and subequal, six very small and sometimes rudimentary. Cœnenchyma very dense and solid, becoming slightly reticulate in the internal portion of the apical parts of the branches and branchlets surface finely echinulate or granulated.

This species, though having much of the habit and size of *Anacropora forbesi*, Ridley, is very distinct in the nature of its cœnenchyma, which is dense and firm, rendering the corallum heavy. The calicles are also smaller and less raised, and the septa less developed. Only two fragments of this species were obtained.

Locality.—Kandavu.

Genus 5. *Montipora*, Quoy and Gaimard.

Montipora, Quoy and Gaimard, Voy. de l'Astrol., Zooph., p. 247.
„ Milne-Edwards and Haime, Cor., iii. p. 207.

This genus includes a large number of species, and like the closely related *Madrepora* presents considerable variation in form and structure when the various species are compared. Thus the prominence of the calicles and the papillose nature of the cœnenchyma, which often forms monticular, intercalicinal eminences, are so marked in certain forms that it has been considered not improbable that, on these grounds, the genus may have to be divided. This apparent distinctness has been noticed long ago by Verrill,[1] who at the same time pointed out that the smoothness and evenness of the cœnenchyma and calicles, which are so marked in some ramose forms, pass insensibly into the papillose and prominent condition in others, the two characteristics being even present on different parts of specimens of one and the same species: so that these characters are not available for generic separation.

Again, the characters presented by such massive species as *Montipora foveolata*, in which the septa, which are subequal at their upper part, are considerably sunk in deep pits, at the bottom of which the primary septa are thickened and united, seem at first sight to offer a means of subdividing the genus; but here again the transitional forms through *Montipora caliculata* and *Montipora verrucosa* prevent any such subdivision.

This genus and the allied *Madrepora* furnish striking examples of the difficulty which is constantly encountered in framing generic limitations among the Corals.

Twenty-two species of the genus were obtained.

1. *Montipora palmata* (Dana).

Manopora palmata, Dana, Zoophytes, p. 493, pl. xliv. fig. 2.

The papillæ give a characteristic appearance to this fragile species, and are developed in connection not only with the cœnenchyma but also with the lower edge of the calicles, so as to form prominent, well-marked portions, giving a rough appearance to the corallum. The form and arrangement of these spinules are shown by Dana (pl. xliv. fig. 2*c* and 2*d*). On the under surface of the branches the spinules are often very short, the cœnenchyma becoming in this case simply uneven.

Locality.—Reefs, Fiji.

2. *Montipora fragilis*, n. sp. (Pl. VIII. figs. 1 1*b*).

Corallum small, arborescent, ramose, very light and fragile on the younger parts, becoming denser at the base; branches about 7 mm. thick, much compressed and

[1] *Proc. Essex Inst.*, vol. v. part 3, p. 26.

coalescent, sometimes rounded; branchlets short, somewhat thinner than the branches, generally much compressed, sometimes terete and tapering. Calicles very small and immersed, about 0·25 mm. wide, not crowded, scarcely conspicuous between the close and long papillæ of the surface. Septa unequal, six being distinct, the secondaries rudimentary. Cœnenchyma very light and porous, widely reticulate above, becoming less porous below; surface covered by long very crowded papillæ, which at the basal part of the corallum are short, unequal, generally rounded, about the same size as the cups, and closely crowded by minute spinules, while at the distal part they are very elongated, thinner, and somewhat raggedly divided into spinules.

This species is close to *Montipora palmata*, but is distinguished by its lighter and more porous structure, by the much smaller and less crowded calicles, and by the much more densely papillose nature of the surface, the papillæ being much more elongated and ragged, especially towards the distal parts.

Locality.—Banda.

3. *Montipora rubra* (Quoy and Gaimard).

Alveopora rubra, Quoy and Gaimard, Voy. de l'Astrol., Zooph., p. 242, pl. xix. figs. 11–14.
Montipora rubra, Milne-Edwards and Haime, Cor., iii. p. 209.

Several small specimens were obtained which seem referable to this species. The corallum, especially at the basal parts, is compressed, becoming subterete and attenuated above, though often rounded at the end. The surface is destitute of spinules or tubercles, but is rendered very uneven owing to the slightly raised, outer borders of the deeply placed calicles, which are thus surrounded by small, and rather fragile, subpolygonal or subcircular projections.

Montipora poritiformis, Verrill, is very close to this species, but apparently is separated by its round branches, and the less-developed projections around the calicles.

Locality.—Reefs, Fiji.

4. *Montipora levis*, n. sp. (Pl. VIII. figs. 2–2*a*).

Corallum small, ramose; branches about 7 mm. thick, much compressed and coalescent, forming broad, palmated expansions, sometimes subterete; branchlets somewhat thinner than the branches, subterete and generally acuminate, rather short, often compressed. Calicles immersed, small and crowded, from about 0·25 to 0·5 mm. wide, and from 1 to 1·25 mm. apart. Septa very thin, the primaries conspicuous and broad, the secondaries very small. Cœnenchyma finely porous, becoming dense below. Surface very finely spinulose or granulated, reticulate and even, sometimes slightly roughened, never papillose nor tuberculate.

This species, though agreeing in general habit with *Montipora palmata*, differs markedly in the nature of its surface, which brings it into close relation with *Montipora poritiformis*, *Montipora digitata* and *Montipora tortuosa*. A variety occurs on the Fiji Reefs which is very close to *Montipora digitata*, but differs in its much more compressed branches, and in its cells, which are not sunk towards the extremities of the branches in large depressions, so as to give a pitted appearance to the surface. The presence of large, pit-like depressions, in which the calicles are situated, forms an essential character of each cell of *Montipora digitata*, as described by Dana.

Localities.—Banda; reefs, Fiji.

5. *Montipora rigida*, Verrill.

Montipora rigida, Verrill, Proc. Essex Inst., vol. v. part 3, p. 26

A very interesting specimen of this species was obtained. The cœnenchyma is very firm, but at the extremities of the well-developed branches and branchlets it becomes very loose and porous, and almost fragile. The calicles of the basal parts are as described by Verrill, but they are easily abraded, and thus become even with the surface. At the apical parts they are not prominent, but are surrounded by a thin, scarcely raised line.

Brüggemann has referred this species to *Montipora* (*Madrepora*) *limitata*, Ellis and Solander, but the identification seems to me doubtful.

Locality.—Mactan Island, Philippines.

6. *Montipora irregularis*, n. sp. (Pl. VIII. figs. 4–4*a*).

Corallum incrusting and spreading at the base, forming thick, irregular, nodular processes above, which develop into much divided branches. Branches thick, closely placed, ascending, often coalescent, and becoming broad and almost palmated; very unequal in length and thickness, compressed, subterete or nearly round, never angular. Branchlets about 12 mm. thick, sometimes compressed, generally rounded, scarcely elongated, and tapering slightly to an obtuse apex. Calicles quite immersed, rather large, about 1 mm. wide, slightly larger on the prominent parts, very crowded, separated by spaces generally much narrower than their diameter, very deep. Septa of two cycles, unequal, rather prominent, and very thin. Cœnenchyma, extremely porous; surface furnished neither with papillæ nor tubercles, but having the narrow intercalicinal spaces delicately echinulate.

This species has many points of resemblance both with *Montipora divaricata*, Brüggemann, and with *Montipora digitata* (Dana), but can be readily distinguished from both of these forms.

Locality.—Samboangan, Philippines.

7. *Montipora obtusata*, n. sp. (Pl. VIII. figs. 3 3*a*).

Corallum consisting of a broad, spreading, rather thin, and unevenly undulated plate, uniformly about 5 mm. thick, from the upper surface of which arise numerous short, thick, obtuse, sometimes subclavate, slightly compressed, irregular branches which may be as much as 2·5 cm. long and 1 cm. thick, and may coalesce laterally to form thick masses. The edge of the plate is slightly turned up, rounded, and uniformly thick: the under surface is covered by a slight epitheca and incrusted by foreign matter almost to the margin where a few small calicles are found. Calicles small, about 0·5 mm. wide, immersed, never sunk in pits, but even with the surface, from about 1 to 2 mm. apart; septa twelve, unequal, almost filling up the cavity of the cell, the secondaries often rudimentary. Cœnenchyma finely reticulate, but firm and rather dense; surface nearly smooth, very minutely spinulose, never papillose nor tubercular.

The broad, spreading, basal plate, with the short, erect lobes or branches, the smooth surface, and the characters of the calicles, will readily serve to distinguish the species.

Locality.—Reefs, Fiji.

8. *Montipora patula*, Verrill.

Montipora patula, Verrill, Proc. Essex Inst., vol. vi. p. 87.

This species is represented by a very fine specimen, which at its centre incrusts dead branches of *Madrepora*, and has numerous short prominences on its upper surface due to the presence of parasitic growths. The cells are normally twelve-rayed, but in many parts, towards the edges of the corallum, the septa of the second cycle are quite rudimentary.

Locality.—Amboina.

9. *Montipora exserta*, n. sp. (Pl. VIII. figs. 5–5*b*).

Corallum forming a rather thin, flattened, broad, horizontal plate, about 8 mm. thick, lessening in thickness towards the edges, but never very thin, even close to the margin; often incrusting foreign matter and thus becoming uneven. The cœnenchyma is dense throughout and evenly reticulate, the surface appearing almost smooth, being very finely and minutely echinulate, never papillose nor tubercular. The under surface is covered to a short distance from the edge by a layer of rudimentary epitheca and foreign matter; and where this is very thin or absent, the finely spinulose cœnenchyma, and small, immersed calicles, which are evenly and closely arranged throughout, are distinctly seen. On the upper surface the calicles are rather large, about 0·75 mm. in diameter, immersed, very regularly arranged, about 1 mm. apart or less. Septa twelve, the secondaries very small; two opposite primary septa much enlarged and exserted, so as to be easily seen

projecting above the surface as small points, separated above by a small notch, but uniting into a plate across the cavity of the cell. This condition is much more marked towards the central parts, where the prominent septa give a somewhat bristling aspect to the corallum.

The closest ally of this very distinct species is *Montipora complanata* (Lamarck). A single specimen was obtained, the growth of which is frequently disturbed by worm tubes.

Locality.—Wednesday Island, Torres Straits, 8 fathoms.

10. *Montipora foliosa* (Pallas).

Madrepora foliosa, Pallas, Elench. Zooph., p. 333.
Montipora foliosa, Milne-Edwards and Haime, Cor., iii. p. 212.

This common species is represented by numerous specimens and fragments.

Locality.—Amboina.

11. *Montipora exesa*, Verrill.

Montipora exesa, Verrill, Proc. Essex Inst., vol. vi. p. 84.

A large fragment in the collection is referable to this species, which was described by Verrill from a single large frond. The basal part of the outer fronds is largely incrusted by *Millepora gonagra*, and above the incrustation the surface is finely papillose; among the papillæ several rather large, raised cells occur bearing numerous smaller papillæ. Towards the edges the calicles are fewer and scarcely raised, and the surface is very finely striated and porous, and destitute of papillæ. The inner fronds are scarcely papillose.

The species is very close to *Montipora lima*.

Locality.—Samboangan, Philippines.

12. *Montipora lima* (Lamarck).

Agaricia lima, Lamarck, Hist. Anim. sans Vert., ii. p. 243, 1816.
Montipora lima, Milne-Edwards and Haime, Cor., iii. p. 213.

This species is represented by a fine and large specimen. On the basal parts of the more exposed, upper fronds, the papilliform ridges and crests become much thicker and higher, and more irregular than on the others. The calicles on the under side are very small and sparse at the edges, but become larger and more numerously placed at the basal part, where, in the outer fronds, the surface is closely and finely papillose.

Locality.—Samboangan, Philippines.

13. *Montipora grandifolia* (Dana).

Manopora grandifolia, Dana, Zoophytes, p. 499, pl. xlv. fig. 1.

Two fragments were obtained. The specimen was evidently of small growth, the fronds being scarcely 5 cm. high, with a thickened base by which they were attached. The small, crowded, short cells cover almost the entire outer surface, except for a very short distance from the upper edge.

Locality.—Api, New Hebrides.

14. *Montipora papillosa* (Lamarck).

Agaricia papillosa, Lamarck, Hist. Anim. sans Vert., ii. p. 243, 1816.
Montipora papillosa, Milne Edwards and Haime, Cor., iii. p. 216, pl. E 3, fig. 2.

A small incrusting specimen of this species was obtained. The longitudinal series of papillæ are very distinct, but at times they are very small and angular, not thick and rounded.

Locality.—Tahiti.

15. *Montipora verrucosa* (Lamarck).

Porites verrucosa, Lamarck, Hist. Anim. sans Vert., ii. p. 271, 1816.
Montipora verrucosa, Milne-Edwards and Haime, Cor., iii. p. 214.

A few small specimens were obtained. The species, apparently, may assume a branched form, for in one specimen a small branch has developed on one of the gibbosities. The comparatively large, open, deep cells, with the alternately large and small septa meeting at the bottom of the cell, will serve to distinguish this species from *Montipora capitata* (Dana).

Locality.—Reefs, Honolulu, and from depths of 1 to 2 fathoms.

16. *Montipora capitata* (Dana).

Manopora capitata, Dana, Zoophytes, p. 504, pl. xlvii. fig. 4.

Small specimens of this species were obtained. Though very close to *Montipora verrucosa*, it seems to be sufficiently distinguished by its decidedly branched form, its smaller cells, and the broader septa, which tend to fill up the cavity of the cell, as well as by the thinner, closer, and more unequal tubercles of the surface.

Locality.—Reefs, Honolulu, and from depths of 1 to 40 fathoms.

17. *Montipora foveolata* (Dana).

Manopora foveolata, Dana, Zoophytes. p. 507.

The walls of the calicles in this species are very finely porous, often much thickened, and frequently, at the angles of the calicles, they are much and sharply elevated. The

twelve septa are subequal at their upper portion and project but slightly into the fossa, but at the bottom of the calicles the primaries become thickened, and meet at the centre.

The wide pits and deeply immersed cells of this species give it a characteristic appearance. In the structure of its cells it much resembles *Montipora verrucosa*. In general form it is very like the figure of *Porites reticulosa* given by Dana.[1]

Locality.—Kandavu.

18. *Montipora caliculata* (Dana).

Manopora caliculata, Dana, Zoophytes, p. 492, pl. xliv. fig. 1.

A fragment of a specimen was obtained. The species has, at first sight, much of the aspect of an incrusting *Madrepora*, but it differs essentially from the forms of that genus in the fact that growth does not take place by budding around one or more leading calicles. The developing calicles arise irregularly from the cœnenchyma, and are generally much more prominent than the adjoining calicles, and thus give an uneven surface to the corallum. The species is very close to *Montipora foveolata*, from which it differs chiefly in its smaller calicles, which are generally distinctly separated by rounded walls, and in its less porous and more spinulose cœnenchyma. The twelve septa are deeply sunk within the calicle, and are exceedingly narrow, leaving a wide central cavity. At the bottom of the calicle the primaries are thicker than the secondaries and are united to one another at the centre.

Locality.—Kandavu.

19. *Montipora scabricula* (Dana).

Manopora scabricula, Dana, Zoophytes, p. 502, pl. xlvi. fig. 3.

A single large specimen was obtained. The edges of the corallum are rather thickened, closely adherent or slightly folded under. The surface is closely and minutely spinulose, but the spinules are very unequal and are frequently placed close to the calicles, which thus become, apparently, somewhat prominent. This character, taken with the small, irregular gibbosities of the surface, gives the corallum a rather rough and peculiar appearance. The six primary septa meet at the centre deep down in the cell, where two of them are usually more thickened and prominent.

Locality.—Reefs, Fiji.

[1] Zoophytes, pl. lvi. fig. 3.

20. *Montipora erosa* (Dana).

Manopora erosa, Dana, Zoophytes, p. 504, pl. xlvi. fig. 5.

The specimen in the collection is much worn, thick and massive. The lobes are much less angular than in Dana's figure; and the cells are twelve-rayed, six being large and conspicuous, and the others very small and spinulose.

Locality.—Mactan Island, Philippines.

21. *Montipora effusa* (Dana).

Manopora effusa, Dana, Zoophytes, p. 500, pl. xlvi. fig. 4.

The single specimen is a thin and widely explanate, incrusting plate, which is free at the margin for a considerable distance. The surface consists of a very open and evenly reticulated cœnenchyma, becoming denser within. The spinules are rather large, and are closely gathered around the cups on all the raised portions of the corallum, becoming small and often absent on the concave portions. It seems altogether a rather delicate variety of the species.

Locality.—Samboangan, Philippines.

22. *Montipora aspera*, Verrill.

Manopora crista-galli, Dana (non Ehrenberg), Zoophytes, p. 494, pl. xlvi. fig. 1.
Montipora aspera, Verrill, in Dana, Cor. and Cor. Islands, p. 333.

This species differs from *Montipora crista-galli* chiefly in its much more massive and uneven growth, the branches being scarcely laminate. The whole corallum is rendered extremely rough by the development of numerous angular wings, crests, and short, longitudinal rows of papillæ, which are very irregularly scattered. The calicles are very distinct, rather close between the crests and angular branches, and somewhat indistinctly and unequally six-rayed; in many cells a rudimentary second cycle is developed.

Locality.—Tahiti.

Family Poritidæ.

Genus 1. *Porites*, Lamarck.

Porites (pars), Lamarck, Hist. Anim. sans Vert., ii. p. 267, 1816.
" Milne-Edwards and Haime, Cor., iii. p. 173.
" Duncan, Rev. Madrep., p. 187.

It has already been shown by Verrill in his description of the Corals of the West Coast of America that the presence of two cycles of septa is not always characteristic of

Porites, for a much larger number of septa frequently occurs. In a very interesting new species, *Porites mirabilis*, obtained by the Challenger from the reefs at Mactan Island, this condition is more highly developed than in any of the species from the American coast. In this species many very large calicles are found, often at close intervals, among the ordinary sized calicles; and in these large calicles three or four cycles of septa are present, the fourth cycle being more or less incomplete. In correspondence with this, the number of pali is also increased, twelve, sixteen or more being present in these cups.

The most interesting character, however, which is revealed by these specimens is the occurrence of the mode of increase by fission in *Porites*, a condition which has usually been regarded as absent in the Poritidæ, in which gemmation was constantly observed. Fission occurs in not a few of the smaller calicles, and is normal in the larger kind of calicles.

The occurrence at Mactan Island of this very marked species, which presents characteristics hitherto observed only in species from the West Coast of America, is an extremely interesting fact. The Coral fauna of the West Coast of America is thus closely related to that of the Western Pacific districts, not only through this form, but also through the new species *Dendrophyllia conferta*, from Australia, which very closely resembles *Dendrophyllia surcularis*, from the American coasts, and through *Stephanaria stellata*, which is found on the American coasts and in the Sandwich and Fiji Islands.

Eighteen species of this genus were obtained.

1. *Porites clavaria*, Lamarck.

Porites clavaria, Lamarck, Hist. Anim. sans Vert., ii. p. 270, 1816.
" " Milne-Edwards and Haime, Cor., iii. p. 175.

This species, as pointed out by Pourtalès, is very close to *Porites furcata*, and it becomes a matter of difficulty in some cases to distinguish between them. Apart from the size and shape of the corallum, the development of the columella, however, seems to be a generally constant character. In *Porites furcata* the columella is usually scarcely visible in the small cell, while in the larger cells of the *Porites clavaria* it becomes comparatively large and but slightly smaller than the pali.

The specimens in the collection are about 13 cm. high, with diverging, scarcely compressed, dichotomously divided branches, 2 cm. thick. They are much thicker than, but otherwise not unlike, the specimen figured in the Report on the Florida Reefs, pl. xii. fig. 7, which Pourtalès has referred to *Porites furcata*, but the calicles of which, figured on pl. xvi. fig. 14, seem to be characteristic ones of *Porites clavaria*.

Locality.—Bermuda.

2. *Porites bulbosa*, n. sp. (Pl. XI. figs. 7-7*a*).

Corallum slightly incrusting at the base, much ramose; branches rather short, thick, subterete or slightly compressed, sometimes coalescent, terminating above in much swollen, clavate knobs with truncated apex, often bifurcate and generally much constricted at the basal part of the knob. Calicles rather small, about 1·5 mm. wide, often less, superficial on the incrusting part, and slightly excavated above, never deep; in those calicles on the inner part of the corallum the walls are generally thin, with distinct septa, and a distinct circle of small pali enclosing a small styliform columella; in those on the outer part the walls are thick, from one-quarter to one-half the diameter of the cell, with a very distinct circle of larger and longer pali surrounding a larger columella, but the septa are much shorter, and less clearly distinct from the wall. The wall is reticulated and rather ragged, and the septa and pali are granulated. Texture firm, reticulated and porous, especially at the apical parts.

This species though close to, is easily separable from *Porites mordax*. In the general form of the corallum it closely resembles *Porites clavaria*. It is represented by a fine and large specimen, the knobs of which are about 25 mm. thick, lessening to 15 mm. at the constricted part.

Locality.—Reefs, Honolulu, and at depths of from 1 to 2 fathoms.

3. *Porites palmata*, Dana.

Porites palmata, Dana, Zoophytes, p. 558, pl. liv. fig. 3.

A very fine example and some small fragments of this species were obtained. The cells are of very variable size, from 1 to 2·5 mm. wide; and the pali are distinct, long, thin, and prominent.

Localities.—Samboangan, Philippines; Amboina.

4. *Porites compressa*, Dana.

Porites compressa, Dana, Zoophytes, p. 553, pl. liii. fig. 5.

The walls of the calicles throughout are very finely and raggedly spinulose, and owing to this the specimen is very rough to the touch. The septa are very granulated and spinulose; the pali very distinct, small and generally elongated, and the columella elongated and distinct, though small.

A single rather small specimen was obtained.

Locality.—Honolulu.

5. *Porites explanata*, n. sp. (Pl. XI. figs. 3–3*a*).

Corallum incrusting, thin, about 2·5 mm. thick, explanate, undulate, or gibbously convex, sometimes mammillate, fixed at the central part and free for a large portion at the margin, which is unevenly flexed. Under surface with a strong epitheca, distinctly striated and concentrically ridged. Calicles from about 1 to 1·5 mm. wide, very shallow, almost inconspicuous owing to the walls being scarcely distinct, very porous and loosely reticulate. Septa generally indistinct and unequal, joined within, the second cycle generally incomplete; pali four, five or six, small, almost indistinguishable from the echinulations of the wall, but always surrounding a small and distinct depression in which no columella can be perceived. Texture light and porous.

A single small specimen of this species was obtained. It has much general resemblance to an explanate *Montipora*, and in its essential characters presents on the one hand an approach to that genus, and on the other to *Synaræa*.

Locality.—Samboangan, Philippines.

6. *Porites lichen*, Dana.

Porites lichen, Dana, Zoophytes, p. 357, pl. lvi. fig. 4.

A very large specimen and several fragments show well the variation in form of this species. The edges are free for a very large portion, undulate and revolute, and often quite thin and contorted, but sometimes rather thickened and mammillate; the fixed and incrusting, central portion is quite thick and mammillate. The cells are from 1 to 2 mm. wide, rather shallow, but never superficial; the pali are small and often scarcely apparent; the walls are thin and raised and have a somewhat ragged outline.

The characters of these specimens seem to point to the identity of *Porites lichen* and *Porites reticulosa*.

Locality.—Reefs, Honolulu, and from depths varying from 1 to 40 fathoms.

7. *Porites guadalupensis*, Duchassaing and Michelotti.

Porites guadalupensis, Duchassaing and Michelotti, Mém. Cor. des Antilles, p. 83.

The species is closely allied in the sum of its characters to the massive species, *Porites arenosa* and *Porites conglomerata* from the Pacific and the Red Sea. Its walls are subcircular or neatly polygonal, thin and raised, being very distinct, resembling the structure in *Rhodaræa*. The septa are thin at their upper part, projecting but slightly from the wall, thick and projecting almost to the centre within, where the pali are found to be irregularly developed and inconspicuous, from six to one in number, or absent. Columella almost invariably absent. Size of calicles about 2 mm.

Specimens of this species were found with *Porites superficialis*, forming bright yellow, or whitish-pink, rounded masses in the rock pools.[1]

Locality.—St. Vincent, Cape Verde Islands.

8. *Porites superficialis*, Duchassaing and Michelotti.

Porites superficialis, Duchassaing and Michelotti, Mém. Cor. des Antilles, p. 82.
Neoporites michelini, Duchassaing and Michelotti, Suppl. Mém. Cor. des Antilles, p. 98., pl. x. figs. 9, 10.

A single specimen of this species was obtained. It forms a small, convex, slightly irregular mass incrusting a nodule of calcareous matter. Of the two species which I have placed together, there does not seem to be any marked character which is not common to both as described by Duchassaing and Michelotti. The very small calicles are specially noticed under *Porites* (*Neoporites*) *michelini*, but this is a most inconstant character in these massive and incrusting species, and at different parts of the same specimen very different measurements can be obtained, depending not only upon the simple size of the calicles, but also on their distance from each other.

Locality.—St. Vincent, Cape Verde Islands.

9. *Porites astræoides*, Lamarck.

Porites astræoides, Lamarck, Hist. Anim. sans Vert., ii. p. 269, 1816.

A specimen of this very common West Indian species was obtained. Very good figures of the species are given in the Report on the Florida Reefs, pl. xvi.

Locality.—St. Thomas.

10. *Porites crassistellata*, n. sp. (Pl. XI. figs. 4–4*a*).

Corallum incrusting at the base, massive, gibbous, unevenly and unequally mammillate. Calicles very uneven, subcircular or angular, rather deep but often very shallow, rather large, about 2 mm. wide, often less, arranged either in series along raised, ridge-like projections and in corresponding depressions, or scattered irregularly, many being much raised above surrounding ones; walls very thick, angular, unequally raised and thickened, having at times the appearance of tubercles between the cups; by the development of young calicles on the raised, thickened portions of the wall, the surface becomes very uneven, and often ridged; septa rough, unequal, thick, often united within, but scarcely prominent on the upper part of the wall. Interseptal spaces very narrow and slit-like. Pali from six to eight, thick and blunt, distinct and long in a few cups, but generally

[1] Moseley, Notes by a Naturalist on the Challenger, p. 48.

short and not at all prominent. Columella very small and generally inconspicuous, often absent. Surface very granulated and minutely spinulous. Texture of corallum rather dense and heavy, closely reticulate or fissured.

In general appearance this species somewhat resembles *Porites astræoides*, but its structure is quite different. A single small specimen was obtained.

Locality.—Kandavu.

11. *Porites arenosa* (Esper).

Madrepora arenosa, Esper, Pflanz. Forts., i. p. 80, Madrep. pl. lxv.
Porites arenosa, Milne-Edwards and Haime, Cor., iii. p. 180.

This widely distributed species is represented by numerous specimens. It is very close to *Porites lutea*, but seems to be sufficiently distinguishable by the much more lobed and mammillated corallum, by the very thin and small, elongated cells in the depressions, by the deeper cells with very conspicuous interseptal spaces, by the longer and thinner pali, and by the more spinulous walls.

Localities.—Tahiti; Tongatabu; Banda; Kandavu, and other reefs, Fiji.

12. *Porites gaimardi*, Milne-Edwards and Haime.

Porites gaimardi, Milne-Edwards and Haime, Cor., iii. p. 179.

A single specimen was obtained. It forms a thick, erect, rather elongated mass, slightly flattened above. The cups are about 1·5 mm. wide, and the columella is very distinct, though small.

Locality.—Banda.

13. *Porites crassa*, n. sp. (Pl. XI. figs. 2–2*a*).

Corallum massive, uneven, irregularly monticulose and mammillate, incrusting at the base. Calicles deep, moderately large, from 1·5 to 2 mm. wide, not plane at the bottom; walls spinulous, sometimes thin, but generally very thick and porous, being about one-fourth or one-half the width of the cell; young developing cells very abundant on the thick walls. Septa subequal, often rather thick and prominent, joined two and two in the depth of the cup, where a very distinct circle of well-developed, rather long, generally thin and pointed pali is visible. The interseptal spaces very wide and distinct. Columella absent or quite inconspicuous. Texture very porous but firm.

This species has many points of resemblance with *Porites fragosa*, but differs markedly in its deep cells which are not plane at the bottom, and also in its thicker walls and larger cells. A single small specimen was obtained.

Locality.—Reefs, Fiji.

14. *Porites lutea*, Milne-Edwards and Haime.

Porites lutea, Milne-Edwards and Haime, Cor., iii. p. 180.
" " Klunzinger, Cor. roth. Meer., ii. p. 40, pl. v. fig. 16.

A small specimen was obtained. It differs in no important particular from the Indian Ocean specimens of the species.

Locality.—Mactan Island, Philippines.

15. *Porites parvistellata*, n. sp. (Pl. XI. figs. 8–8*a*).

Corallum massive, convex or subcolumnar, unevenly gibbous and closely monticulose, or small-mammillate, incrusting at the base. Calicles polygonal, very small, about 1 mm. wide, sometimes less, deep, becoming rather shallow on the incrusting part, not plane at the bottom; walls acute, very thin above, rather thick below, nearly solid. Septa unequal, short, narrow, nearly solid, often joining two and two deep down in the cup, where a circle of small, often elongated pali is visible. Columella absent or inconspicuous. Texture very firm and compact for the genus; the interseptal spaces being very small.

The mode of growth, the compact texture, and the very small and deep cups, with thin, acute walls and narrow, short septa, distinguish this species. Two small specimens were obtained; one of which is about 7 cm. high and 5 cm. broad, not unlike an enlarged mulberry in appearance.

Locality.—Api, New Hebrides.

16. *Porites tenuis*, Verrill.

Porites tenuis, Verrill, Proc. Essex Inst., vol. v. pt. 3, p. 25.

Very interesting specimens of this species were obtained. They occur either as unattached, rounded and uneven masses, covered over the whole surface by living polyps, or attached, being then fixed by a narrow base or growing incrusting over stones and other foreign material. The walls are very thin and porous, the central portion slightly raised, very neatly polygonal, and conspicuous on the surface as fine lines. The septa, pali, and columella are small and very distinct; and the small interseptal spaces are very conspicuous.

In one specimen, which is fixed and very broad, the summit is dead owing to exposure in an insufficient depth of water, while growth has continued in a lateral direction.

Localities.—Api, New Hebrides; Honolulu, at depths of from 1 to 2 fathoms.

17. *Porites mirabilis*, n. sp. (Pl. XI. figs. 5–5*a*).

Corallum massive, convex and gibbous, incrusting at the base. Calicles very unequal, of two distinct sizes, with many intermediate ones; the smaller more numerous, from 1 to 1·5 mm. wide, sub-polygonal, nearly superficial, but slightly excavate, with rather narrow, acute walls, often thickened and very porous, with very thin septa, five or six unequal, distinct, long pali, and a styliform columella. The larger calicles often closely gathered together, but generally separated by from two to five smaller ones, about 2·5 mm. wide, sometimes more, much more excavated than the small ones, with very thin and closely placed septa of three or four cycles, the fourth cycle being incomplete, with from twelve to sixteen, or more, thin and distinct pali surrounding a styliform, or subtrabeculate, or porous columella. Texture close and firm, very finely reticulated.

A single small specimen, nearly 8 cm. in diameter, was obtained. It is easily distinguishable from all other known species of the genus, though an approach is made to it by *Porites porosa* and *Porites excavata*, from the West Coast of America.

Locality.—Mactan Island, Philippines.

18. *Porites latistellata*, n. sp. (Pl. XI. figs. 6–6*a*).

Corallum incrusting at the base and almost massive, becoming subramose or deeply lobate above, the lobe-like branches being from about 1 to 2 cm. thick, about 2 cm. long at the outer part of the colony, but very short and almost suppressed towards the central portion; slightly swollen and fragile at the apex, subtruncate, very coalescent and often compressed. Calicles angular, large, about 3 mm. wide; towards the basal parts they are often smaller, and almost or quite superficial, the walls being very thin, acute, and slightly raised, often almost indistinguishable; towards the apical parts the calicles are deeper, and on the subtruncate ends they become much excavated, though never as deep as they are wide, with very thin, acute, subcircular or elongated walls. Septa from twelve to sixteen, often rather indistinct, joined at the centre, and ragged, bearing numerous paliform lobes; in the superficial calicles they are rather distinct, with from six to eight small pali surrounding a porous columella; in the deep calicles they are often almost indistinguishable, very porous and trabeculate, while the pali form a distinct, circular, raised, trabeculate mass nearly confluent with the columella. Texture exceedingly light and loosely porous, surface very spinulose and granulated.

In the shape of its cells the species has much in common with *Porites favosa*; while many of its essential characters indicate an approach to the genus *Napopora*. A rather large specimen was obtained.

Locality.—Tahiti.

Genus 2. *Napopora*, Quelch.

Napopora, Quelch, Ann. and Mag. Nat. Hist., vol. xiii., 1884, p. 296.

Corallum compound, porous. Gemmation intracalicinal, the developing buds with distinct centres, almost destitute of distinct walls, at first united in groups of from two to six, and surrounded by the common wall of the parent calicle; but as development proceeds, they are separated off by a narrow, raised, distinct wall. Calicinal depressions very variable in size and shape, according to the number, position, and degree of development of the buds. Walls of the older calicles porous, distinctly raised, angular. Septa generally of two cycles, rudimentary. Pali six, sometimes one smaller than the others or absent, generally well developed, and distinctly marking the position of the calicinal centres. Columella rudimentary, represented by small, papilliform projections, often absent.

This genus is peculiar among the Poritidæ in the arrangement of its calicles, which present an approach to a meandrine condition. Its closest ally is *Synaræa*, but in this latter genus the walls are not developed.

Napopora irregularis, Quelch (Pl. VIII. figs. 6–6*a*).

Napopora irregularis, Quelch, Ann. and Mag. Nat. Hist., vol. xiii., 1884, p. 296.

Corallum ramose; branches rather short, moderately thick, obtuse, and slightly or not at all compressed. Calicles very variable, seen in all stages of development, with many granular points or flattened projections; the single calicles with distinct walls, subcircular, about 2 mm. in diameter; the larger ones with many distinct centres in the same cavity, surrounded by a common wall, which is raised, angular, and of irregular shape, with a diameter of from 4 to 9 mm. Many of the developing centres present no trace of a wall, others possess walls more or less incomplete; but the centres are easily distinguished by the position of the pali. The septa of two or three cycles, generally twelve, sometimes fewer, rudimentary, sometimes rather distinct at their inner ends, and united two by two where the pali are placed. The pali are generally six in number, prominent, sometimes one very small or absent. Columella inconspicuous.

Of this species there is a single small specimen. It consists of a broken, slightly compressed branch about 5·5 cm. long, with three branchlets, one of which is broken off. The widest diameter of the branches is about 1·25 cm., and of the branchlets about 1 cm., even close to the apex. The surface is delicate and easily abraded. The species presents an approach to *Porites latistellata*.

Locality.—Tahiti.

Genus 3. *Synaræa*, Verrill.

Synaræa, Verrill, Bull. Mus. Comp. Zoöl., Cambridge, U.S.A., i. p. 42.
„ Duncan, Rev. Madrep., p. 187.

A single species of this very interesting genus was obtained.

Synaræa convexa, Verrill.

Synaræa convexa, Verrill, Bull. Mus. Comp. Zoöl., Cambridge, U.S.A., i. p. 43.

The branches in this species are often coalescent throughout, leaving small, very irregular and unequal depressions on the upper surface, in which the cells are delicate and very closely placed. Several pieces of a large specimen were obtained.

Locality.—Tahiti.

Genus 4. *Goniopora*, Quoy and Gaimard.

Goniopora, Quoy and Gaimard, Voy. de l'Astrol., Zooph., p. 218.
„ Milne-Edwards and Haime, Cor., iii. p. 189.
„ Duncan, Rev. Madrep., p. 189.

A single specimen of the typical species of the genus was obtained.

Goniopora pedunculata, Quoy and Gaimard.

Goniopora pedunculata, Quoy and Gaimard, Voy. de l'Astrol., Zooph., p. 218, pl. xvi. figs. 9–11.
„ „ Milne-Edwards and Haime, Cor., iii. p. 190.

A small piece which evidently formed the outer portion of a specimen of this species was obtained.

The depth of the calicles is generally slightly less than their width. The walls are irregularly thickened and perforated, and very nearly indistinguishable in a section of the corallum. The septa are somewhat thickened and narrow, with rather short teeth.

Locality.—Mactan Island, Philippines.

Genus 5. *Rhodaræa*, Milne-Edwards and Haime.

Rhodaræa, Milne-Edwards and Haime, Cor., iii. p. 183.
„ Duncan, Rev. Madrep., p. 188.

Two species of this genus were obtained.

1. *Rhodaræa tenuidens*, n. sp. (Pl. VIII. figs. 7–7*b*).

Corallum subglobose, massive, incrusting at the base, with a narrow, free edge and a thin, distinct epitheca. Calicles scarcely polygonal, subcircular, rather deep, about 3 mm. wide; wall very porous and thin, very much thickened at the points where many cups meet. Septa of three cycles, the last very rudimentary, those of the first and second cycles almost trabeculate and raggedly spinulous below, not distinct above from the porous wall; pali very thin and wide, forming upright, rather broad plates, tending to fill up the cups, often much less elevated, but never forming thick, lobe-like pieces.

This species makes a decided approach to *Alveopora*. It is distinguished from *Rhodaræa calicularis* by the shape of its calicles, the nature of its walls and the characters of its pali. From *Rhodaræa gracilis* it differs in the size and shape of its calicles, and the character of its pali. Two small specimens were obtained.

Localities.—Santa Cruz Major Island, off Samboangan, Philippines, 10 fathoms; Amboina.

2. *Rhodaræa calicularis* (Lamarck).

Astræa calicularis, Lamarck, Hist. Anim. sans Vert., ii. p. 266, 1816.
Rhodaræa calicularis, Milne-Edwards and Haime, Cor., iii. p. 183.

A large portion of a very large, subglobose specimen was obtained. The walls are rather strong and uniformly thick in each calicle, but are very variable at different parts of the corallum; in some places it is low and thick, marked above by the narrow septa; in other places it is elevated and thinner, with the septal marking scarcely distinct. In the shallow calicles the pali are very thick and rounded, very distinct, nearly filling up the cell; in the deeper calicles they are smaller, and much less prominent at the bottom of the cell.

Locality.—Samboangan, Philippines.

Genus 6. *Tichopora*, n. gen.

Corallum compound, porous; gemmation intercalicinal. Walls very slightly developed, extremely trabeculate or porous, those of adjoining calicles adherent or fused together, and barely distinguishable in section separating the septa. Calicles subcircular, rarely subangular, shallow. Septa well developed, of three complete cycles, equal or subequal, all projecting equally to meet the columella where the tertiaries join the secondaries in each system, perforated, trabeculate and slightly echinulate. The interseptal spaces very distinct, deep and regular between the perforated laminæ. Columella well developed, subpapillose or trabeculate, largely formed by the septal ends. Pali represented by thickened, elevated, irregular spinules situated before the second cycle, and almost indistinguishable from the trabeculate ends of the columella.

This genus is extremely close to the fossil genus *Litharæa* from which it is distinguished by the trabeculate, perforated septa, the surfaces of which are nearly smooth within, and by the prominent columella and the paliform spinules. It is distinguished from *Goniopora* by its slightly developed, subcircular wall, which is not elevated to form strong, distinct, trabeculate laminæ, by the equal or subequal, well-developed septa with distinct, wide and deep interseptal spaces, and by the paliform spinules which are more distinct on the central parts of the corallum than on the exterior. From *Rhodaræa* it is distinguished by the slight development of the wall, by the well-developed distinct septa and interseptal spaces, by the abundant columella, and the indistinct paliform spinules.

Tichopora tenella, n. sp. (Pl. XI. figs. 1–1*a*).

Corallum extremely porous, somewhat elevated or ovoid, rounded above, and thicker than at the basal part where it incrusts and sometimes surrounds nodules of foreign matter. Gemmation rapidly taking place in the open spongy tissue enclosed between the walls of three or four adjoining calicles. Wall extremely porous and fragile, so as to be very easily broken away, often quite thin, scarcely raised; the line of union generally apparent externally between the calicles, but very indistinct in section. Calicles from about 5 to 6 mm. wide, quite shallow, nearly circular, sometimes oval or subpolygonal. Three cycles complete, a fourth occasionally represented in the larger cups. Septa thin, forming regularly perforated or trabeculate laminæ quite distinct in section, very echinulate exteriorly, but sparsely so deep down in the interseptal chambers. Pali, consisting of six irregular projections placed before the secondaries, scarcely distinct from the trabeculate spinulose ends of the columella, which forms a marked projection in the centre of the calicles.

This species, though different in essential structure, has a very close external resemblance to *Litharæa websteri*, and might easily be mistaken for a recent form of that species. Only a single small specimen was obtained.

Locality.—Samboangan, Philippines.

Genus 7. *Alveopora*, Quoy and Gaimard.

Alveopora (*pars*), Quoy and Gaimard, Voy. de l'Astrol., Zooph., p. 238.
„ Milne-Edwards and Haime, Cor., iii. p. 193.
„ Duncan, Rev. Madrep., p. 190.

A single species of this very interesting genus was obtained.

Alveopora retusa, Verrill.

Alveopora retusa, Verrill, Bull. Mus. Comp. Zoöl. Cambridge, U.S.A., i. p. 43.

A single small specimen, on which an abundantly developed pellicular epitheca is present, was obtained. The growth of the upper portion of the main lobe of the specimen has been disturbed, evidently owing to injury caused by some foreign body which has settled upon it, the position of which can easily be seen. On this lobe, and especially on its basal portion, the cells are rather small and shallow, with thickened, irregular, spiniform septa, which are seldom more than twelve in number, while the wall is irregularly fenestrate and thickened, and spinulose at its free edge. On a smaller basal lobe the typical structure of the species is more clearly seen, but the characteristic third cycle is not complete.

Locality.—Somerset, Cape York, 5 fathoms.

HYDROCORALLINÆ.

Family Milleporidæ.

Genus *Millepora*, Linnæus.

Millepora (pars), Linnæus, Syst. Nat., ed. 10, p. 790.
" Milne-Edwards and Haime, Cor., iii. p. 225.
" Moseley, Zool. Chall. Exp., pt. vii. p. 18.

Through the researches of Professor Moseley, who has confirmed and extended the observations of Louis Agassiz as to the hydroid nature of the Milleporidæ, we have an accurate knowledge of the structure and affinities of *Millepora*. By the discovery of ampullæ[1] on the new species, *Millepora murrayi*, I have been able to give additional confirmation to the opinion of Professor Moseley on the classification of *Millepora*. The ampullæ, which are described under *Millepora murrayi*, do not seem to differ in any marked particular from those of the Stylasteridæ.

Eight species of the genus were obtained.

1. *Millepora alcicornis*, Linnæus.

Millepora alcicornis, Linnæus, Syst. Nat., ed. 10, p. 791.
" " Dana, Zoophytes, p. 543.

Three specimens of this species were obtained. One, from Bermuda, consists of a very large, curved, flabellate cœnosteum, formed by numerous very coalescent branches

[1] *Nature*, 1884, p. 539.

and branchlets in the same plane, which become quite free and somewhat divergent above. The fenestræ between the coalescent branches are of very different sizes, but are small, and obsolescent towards the basal part which forms a solid mass. A large specimen from St. Thomas differs in being much more unevenly grown, with shorter and thicker branches. The surface is much more uneven, and the pores more conspicuous.

A third specimen, which was obtained at Bermuda, and which does not seem to differ essentially from this species, is peculiar in many respects. It consists of a few small branches growing on an old and broken black bottle, over which, within and without, the basal part of the cœnosteum has spread as a thin incrusting layer. The branches are rather unequally compressed, sometimes coalescing, and palmato-digitate above. The surface of the cœnosteum is of a delicate, reddish-brown colour, and is much more uneven than in the normal form. The cyclosystems are crowded over the surface, and the gastropores are very large.

Very valuable and interesting remarks on the species have been made by Pourtalès,[1] and he points out the great variation to which it is subject. A very good figure of the species is given in the Report on the Florida Reefs, pl. xx.

Localities.—Bermuda; St. Thomas, West Indies.

2. *Millepora carthaginiensis*, Duchassaing and Michelotti.

Millepora carthaginiensis, Duchassaing and Michelotti, Suppl. Mém. Cor. des Antilles, p. 102, pl. xi. fig. 6.

A single large specimen, apparently referable to this species, was obtained. The branches and branchlets are small, slender, and parallel; extremely elongated, and very coalescent, forming broad laminæ with narrow, elongated fenestræ. Often the branches are free throughout all their length, and form long, rod-like, upright pieces. The cyclosystems are very distinct, the gastropores being rather large and sunk in small, shallow depressions. Owing to these small depressions the surface is slightly uneven.

From the foregoing description it will be seen that this species, like the many others described by Duchassaing and Michelotti from the West Indies, is very closely related to *Millepora alcicornis*, and it is very probable, as suggested by Pourtalès, that they are all but varieties of one and the same species.

Locality.—St. Thomas, West Indies.

3. *Millepora murrayi*, Quelch (Pl. VII. figs. 5–5*e*).

Millepora murrayi, Quelch, Nature, 1884, p. 539.

Cœnosteum consisting of dense clusters of broad and thin, compressed, frond-like branches, which are extremely coalescent, and broadly palmate at the ends. The fronds

[1] Illustr. Cat. Mus. Comp. Zool., No. iv.

formed by the coalescent branches and branchlets are often as much as 5 cm. wide, and the thickness of the fronds and branches throughout is uniformly about 5 mm. The broadened extremities of the branches trend horizontally, and become divided vertically into parallel branchlets, which often remain laterally fused, and give a ribbed appearance to the lower part of the frond. The branchlets in their free portion are sometimes as much as 2 cm. long, though they are generally much shorter and irregular, somewhat compressed, about 3 mm. thick, slightly tapering, and rounded at the end; in developing, these branchlets elongate, curve outwards, become horizontally directed, and broadened out into thin, compressed, vertical fronds, from 2 to 5 cm. wide, which become in turn divided vertically into numerous irregular, small, parallel branchlets; these fronds either coalesce laterally with other fronds, or fuse with opposite ones at their extremity, thus forming bridge-like pieces. The surface of the cœnosteum is nearly smooth, being finely and evenly reticulated. The pores are small and scattered irregularly, often scarcely distinguishable over large areas of the cœnosteum; the gastropores are about 0·25 mm. in diameter, and rather wide apart; the dactylopores are very minute and generally very numerous, less abundant on the apical parts of the branchlets and on the basal parts of the colony. Ampullæ developing as special cavities in the superficial meshwork of the cœnenchyma; often crowded, about 0·75 mm. in diameter within, scarcely raised above the general surface, on which they are seen as small white spots or vesicles, which are about 0·5 mm. in diameter, the centre being generally pierced by a small pore.

This species is close to the *Millepora tortuosa*, from the Fiji Islands, but can easily be distinguished from it. I have named it in honour of Mr. John Murray, whose observations on the living zooids of *Millepora* so materially aided Professor Moseley in his researches on the genus.

On dry specimens which have been kept for some time, and on which ampullæ occur, it is easy to demonstrate their presence by the comparatively large pits which are formed over the surface by the abrasion of the thin, upper layer which covers them, and which are easily distinguishable from the minute pores of the cyclosystems.

Locality.—Samboangan, Philippines.

4. *Millepora ramosa*, Pallas.

Millepora alcicornis, var. *ramosa*, Pallas, Elench. Zooph., p. 261.
Millepora ramosa, Dana, Zoophytes, p. 544.

Two specimens of this species are in the collection. The main stems are large and strong, being as much as 2·5 cm. in diameter at the base, and the branches rise to a comparatively great height. The cyclosystems are generally well marked; the gastropores are slightly larger than the dactylopores, but both are small.

Professor Moseley remarks that *Millepora ramosa* seems to thrive best in the shade.[1]

Locality.—Bermuda.

5. *Millepora intricata*, Milne-Edwards and Haime.

Millepora intricata, Milne-Edwards and Haime, Cor., iii. p. 229, pl. F 2, fig. 2.

A single small specimen occurs in the collection. The pores in this species are arranged in more or less regular cyclosystems, though numerous dactylopores are scattered throughout the surface of the cœnosteum. The pores are very small, and the dactylopores especially are very minute.

Locality.—Amboina.

6. *Millepora confertissima*, n. sp. (Pl. VII. figs. 4–4*a*).

Cœnosteum consisting of an extremely dense, flat-topped, almost square clump of closely interlaced branches and branchlets, which are intimately coalescent, and so closely placed as to leave only very small and narrow openings between them. Branches compressed and very small, about 4 mm. thick, but generally much wider, very closely and shortly ramose, and often forming fronds by lateral coalescence of its branchlets. Branchlets very small, short, and compressed, from about 5 to 7 mm. long, often less, about 4 mm. wide and 2 mm. thick, subpalmate, bearing a few obtuse, smaller branchlets. Surface very smooth and even. Pores unequal, and not distinctly gathered into cyclosystems; gastropores very small, rather wide apart; dactylopores very minute and numerous. Ampullæ absent.

The peculiarly packed and intimate branching of this species gives it a striking habit, which will easily distinguish it.

Locality.—Ternate.

7. *Millepora nodosa*, Esper.

Millepora alcicornis, var. *nodosa*, Esper, Pflanz., i. p. 199, Millep. pl. ix.
Millepora nodosa, Moseley, Zool. Chall. Exp., part vii. p. 13.

Several fragments and small specimens were obtained. Special interest attaches to this form, since it was on specimens of this species of the genus that the classical researches of Professor Moseley were based.

Locality.—Tahiti.

[1] Notes by a Naturalist on the Challenger, p. 27.

8. *Millepora gonagra*, Milne-Edwards and Haime.

Millepora gonagra, Milne-Edwards and Haime, Cor., iii. p. 230, pl. F 3, fig. 1.

Three specimens occur in the collection. The cœnosteum in the very young stages takes on the peculiar, small-lobed form of the large specimens, and differs in this respect from the long-ridged forms of the young specimens of *Millepora verrucosa*; nevertheless the two species are very closely allied. The pores are scattered irregularly; but often the dactylopores are gathered in large numbers around the gastropores.

Localities.—Samboangan, Philippines; Kandavu; Tahiti.

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Note.—Synonyms are printed in *italics*; when more than one reference is given for any genus or species, the most important is indicated by the darker type.

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PLATE I.

PLATE I.

Fig. 1. *Stylophora flabellata*, a part of the corallum; natural size.

Fig. 1*a*. A calicle; magnified. Surface view.
Fig. 1*b*. The inside of a calicle; magnified.

Fig. 2. *Stylophora cellulosa*, a part of a branch; natural size.

Fig. 2*a*. A typical calicle; magnified. Surface view.
Fig. 2*b*. Magnified view of the inside of a calicle, taken from the extreme apex of a branchlet.
Fig. 2*c*. Magnified view of the inside of a typical calicle.

Fig. 3. *Pocillopora paucistellata*, a part of the corallum; natural size.

Fig. 3*a*. A part of the surface with calicles; magnified.

Fig. 4. *Pocillopora solida*, the main portion of the corallum; natural size.

Fig. 4*a*. A part of the surface, with verrucæ; magnified.
Fig. 4*b*. One of the verrucæ; more highly magnified.
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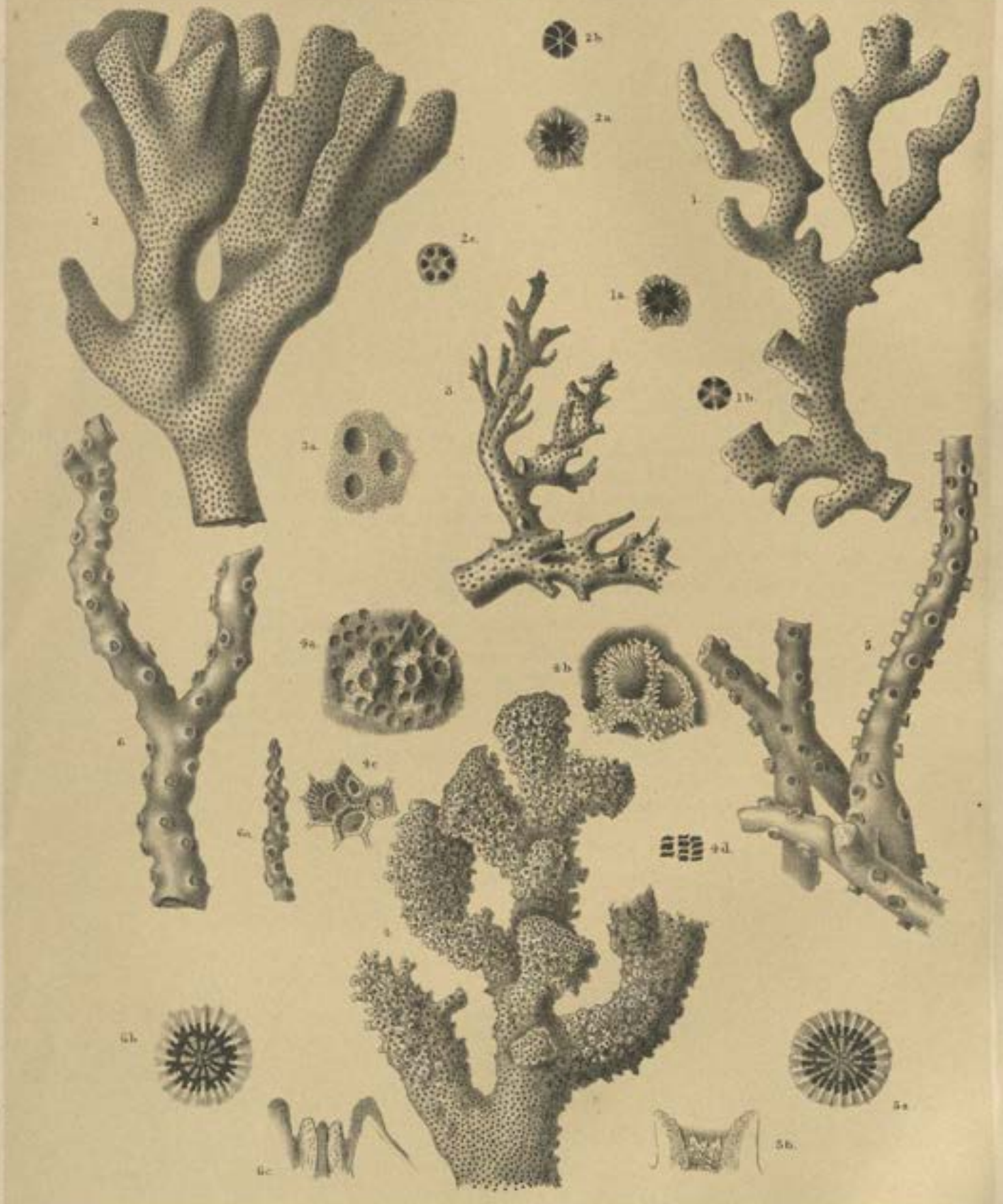
Fig. 4*d*. A vertical section of a part of the apex of a branchlet; magnified.

Fig. 5. *Oculina recta*, a part of the corallum; natural size.

Fig. 5*a*. A calicle; magnified.
Fig. 5*b*. A vertical section of a calicle; magnified.

Fig. 6. *Oculina coronalis*, a part of the corallum; natural size.

Fig. 6*a*. A small branchlet; natural size.
Fig. 6*b*. A calicle; magnified.
Fig. 6*c*. A vertical section of a calicle; magnified.



1. STYLOPHORA FLABELLATA. 2. S. CELLULOSA. 3. POCILLOPORA PAUCISTELLATA.
4. P. SOLIDA. 5. OCULINA RECTA. 6. O. CORONALIS.

PLATE II.

PLATE II.

Fig. 1. *Seriatopora conferta*, a part of the corallum; natural size.

Fig. 1*a*. A typical calicle; magnified. Surface view.
Fig. 1*b*. A basal calicle; magnified. Surface view.
Fig. 1*c*. A magnified view of the inside of a distal calicle.

Fig. 2. *Seriatopora aculeata*, a part of the corallum; natural size.

Fig. 2*a*. A calicle; magnified. Surface view.
Fig. 2*b*. A magnified view of the inside of a calicle.
Fig. 2*c*. A magnified view of the distal, intercalicular surface.

Fig. 3. *Seriatopora crassa*, a part of the corallum; natural size.

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Fig. 3*b*. A magnified view of the inside of a calicle.
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Fig. 3*d*. *Seriatopora crassa*, var. *transversa*; a magnified view of the inside of a calicle.

Fig. 4. *Seriatopora stellata*, a part of the corallum; natural size.

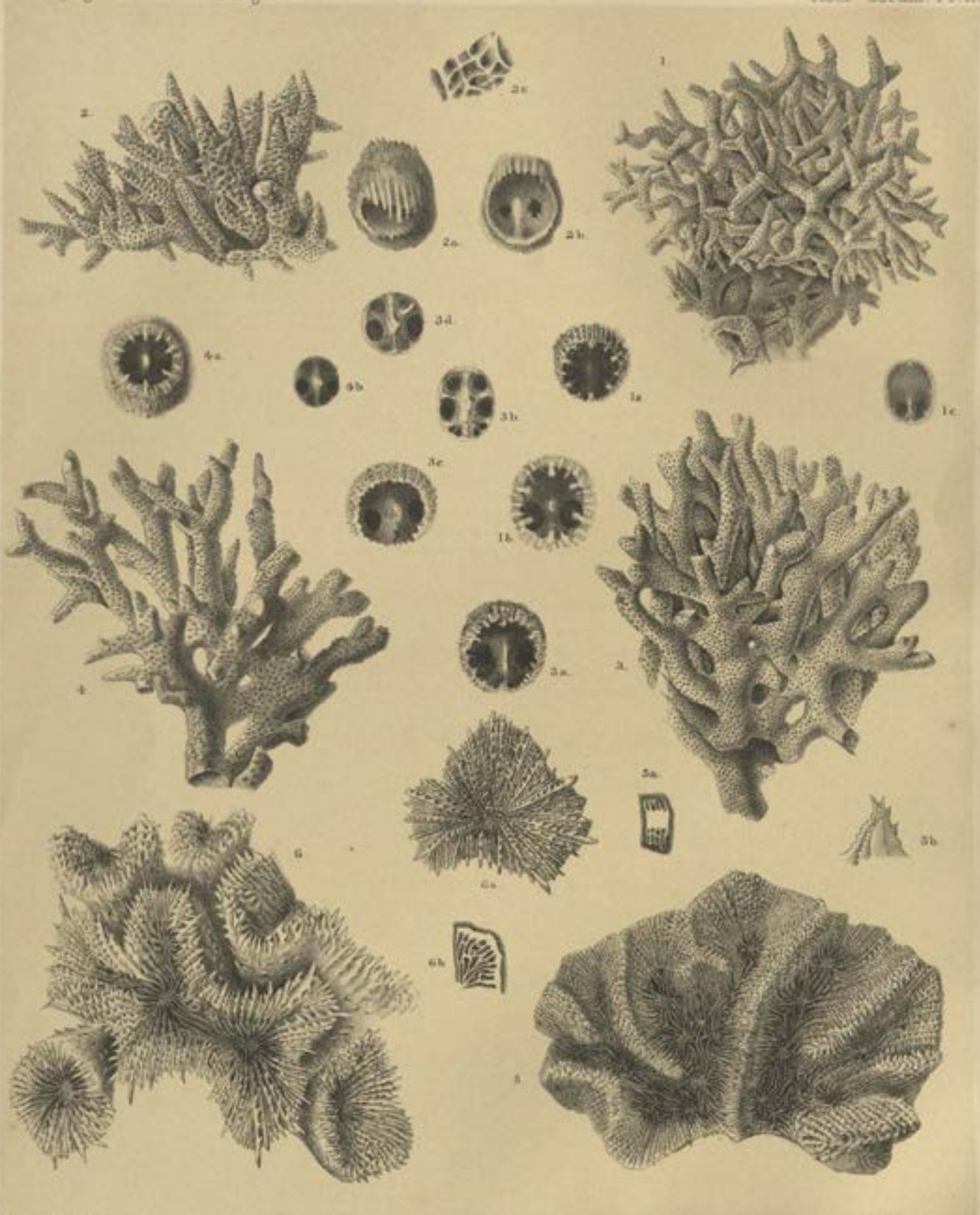
Fig. 4*a*. A calicle; magnified. Surface view.
Fig. 4*b*. A magnified view of the inside of a calicle.

Fig. 5. *Symphyllia acuta*; the corallum; natural size.

Fig. 5*a*. A part of the wall with septa and dissepiments; transverse section.
Fig. 5*b*. A part of the wall with septa; vertical section.

Fig. 6. *Mussa brueggemanni*, a part of the corallum; natural size.

Fig. 6*a*. An isolated calicle; natural size.
Fig. 6*b*. A part of the wall with septa and dissepiments; transverse section.



A. Thomas del. et lith. Mintern Bros. imp.

1. SERIATOPORA CONFERTA. 2. S. ACULEATA. 3. S. CRASSA. 4. S. STELLATA.
5. SYMPHYLLIA ACUTA. 6. MUSSA BRUEGGEMANNI.

PLATE III.

PLATE III.

Fig. 1. *Physogyra aperta*, a part of the corallum; natural size.

Fig. 1a. A part of the wall, with dissepiments; vertical section.

Fig. 2. *Goniastræa multilobata*, a part of the corallum; natural size

Fig. 2a. Magnified view of an elongated calicle, with developing centres.
Fig. 2b. A vertical section of a calicle; magnified.
Fig. 2c. A view of the dissepiments, as seen in a vertical section through the centre of a calicle.

Fig. 3. *Goniastræa coronalis*, a part of the corallum; natural size.

Fig. 3a. A calicle; magnified.

Fig. 4. *Goniastræa laxa*, a part of the corallum; natural size.

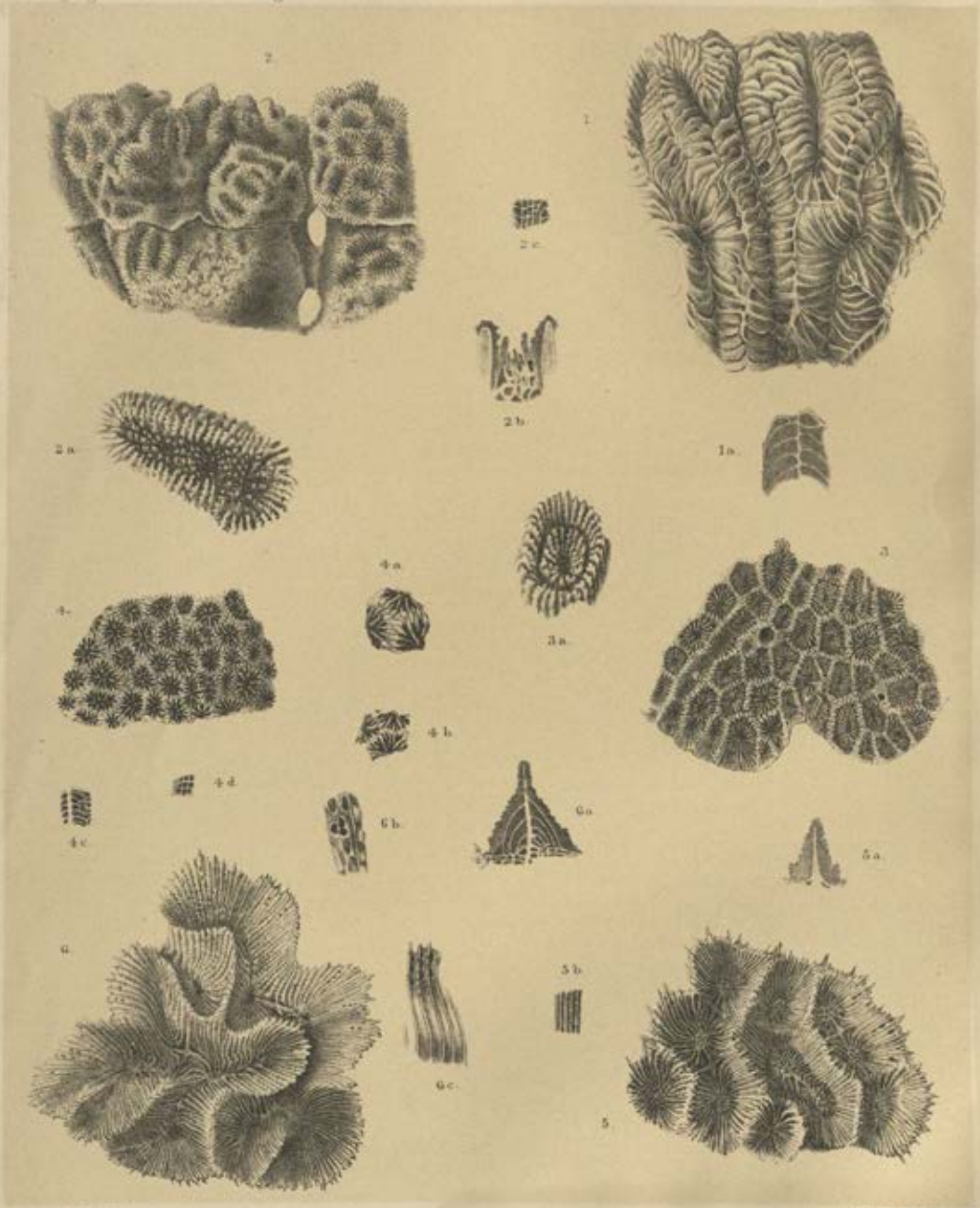
Fig. 4a. A surface view of the wall where it is much thickened.
Fig. 4b. A surface view of the wall where it is thin.
Fig. 4c. A vertical section of a part of the wall, with dissepiments.
Fig. 4d. A view of septa and dissepiments, as seen in a vertical section through the centre of the calicle.

Fig. 5. *Ulophyllia aspera*, a part of the corallum; natural size.

Fig. 5a. A vertical section of a part of the wall, with opposite septa.
Fig. 5b. A view of a part of the under surface, with costæ.

Fig. 6. *Ulophyllia cellulosa*, a part of the corallum; natural size.

Fig. 6a. A vertical section of a part of the wall, with septa and dissepiments.
Fig. 6b. A view of the under surface, with vesicles and costæ.
Fig. 6c. A lateral view of a part of a ridge, with the septa rubbed down to lay bare the abundant endotheca.



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1. PHYSOGYRA APERTA. 2. GONIASTRÆA MULTILOBATA. 3. G. CORONALIS.
4. G. LAXA. 5. ULOPHYLLIA ASPERA. 6. U. CELLULOSA.

PLATE IV.

PLATE IV.

Fig. 1. *Phymastræa aspera*, a part of the corallum ; natural size.

Fig. 1*a*. A vertical section of a part of the wall, with septa and intermural spaces ; magnified.
Fig. 1*b*. A transverse section across a part of three calicles, with intermural spaces.

Fig. 2. *Acanthastræa irregularis*, a part of the corallum ; natural size.

Fig. 2*a*. A magnified view of the wall at the junction of five calicles, with septa

Fig. 3. *Cyphastræa aspera*, the corallum ; natural size.

Fig. 3*a*. A magnified view of a calicle.

Fig. 4. *Cyphastræa brueggemanni*, the corallum ; natural size.

Fig. 4*a*. A part of the corallum ; magnified.

Fig. 5. *Galaxea aspera*, a part of the corallum ; natural size.

Fig. 5*a*. A lateral view of a calicle (restored).
Fig. 5*b*. A section of the cells of the peritheca.
Fig. 5*c*. The cells of the peritheca ; surface view.
Fig. 5*d*. A calicle, seen from above ; magnified.

Fig. 6. *Galaxea explanata*, a part of the corallum ; natural size.

Fig. 6*a*. A calicle, seen from above ; magnified.
Fig. 6*b*. A lateral view of a calicle.
Fig. 6*c*. A section of the cells of the peritheca.
Fig. 6*d*. The cells of the peritheca ; surface view.

Fig. 7. *Galaxea fragilis*, a part of the corallum ; natural size.

Fig. 7*a*. A calicle, seen from above ; magnified.
Fig. 7*b*. A lateral view of a calicle (restored).
Fig. 7*c*. A section of the cells of the peritheca.
Fig. 7*d*. The cells of the peritheca ; surface view.

A. Garnier del et lith. Mintern Bros. imp.

1. PHYMASTRÆA ASPERA. 2. ACANTHASTRÆA IRREGULARIS. 3. CYPHASTRÆA ASPERA.
4. C. BRUEGGEMANNI. 5. GALAXEA ASPERA. 6. G. EXPLANATA. 7. G. FRAGILIS.

PLATE V.

PLATE V.

Fig. 1. *Merulina prolifera*, a part of the corallum ; natural size.

Fig. 1a. A branchlet ; magnified.

Fig. 2. *Oxypora contorta*, a part of the corallum ; natural size.

Fig. 2a. Two calicles ; magnified.
Fig. 2b. A part of the under surface.

Fig. 3. *Tichoseris obtusata*, the corallum ; natural size.

Fig. 3a. A transverse section, showing isolated as well as seriate calicles, with solid walls ; magnified.
Fig. 3b. A magnified view of the marginal part of a calicle, with synapticulæ.
Fig. 3c. A vertical section of the corallum, with endotheca ; magnified.

Fig. 4. *Domoseris porosa*, a part of the corallum ; natural size.

Fig. 4a. A calicle ; magnified.
Fig. 4b. A magnified view of the upper part of the septo-costæ, as seen in a vertical section parallel to their direction.
Fig. 4c. A magnified view of the septo-costæ, as seen in a vertical section, transverse to their direction.

Fig. 5. *Domoseris solida*, a part of the corallum ; natural size.

Fig. 5a. A calicle ; magnified.

Fig. 6. *Domoseris regularis*, a part of the corallum ; natural size.

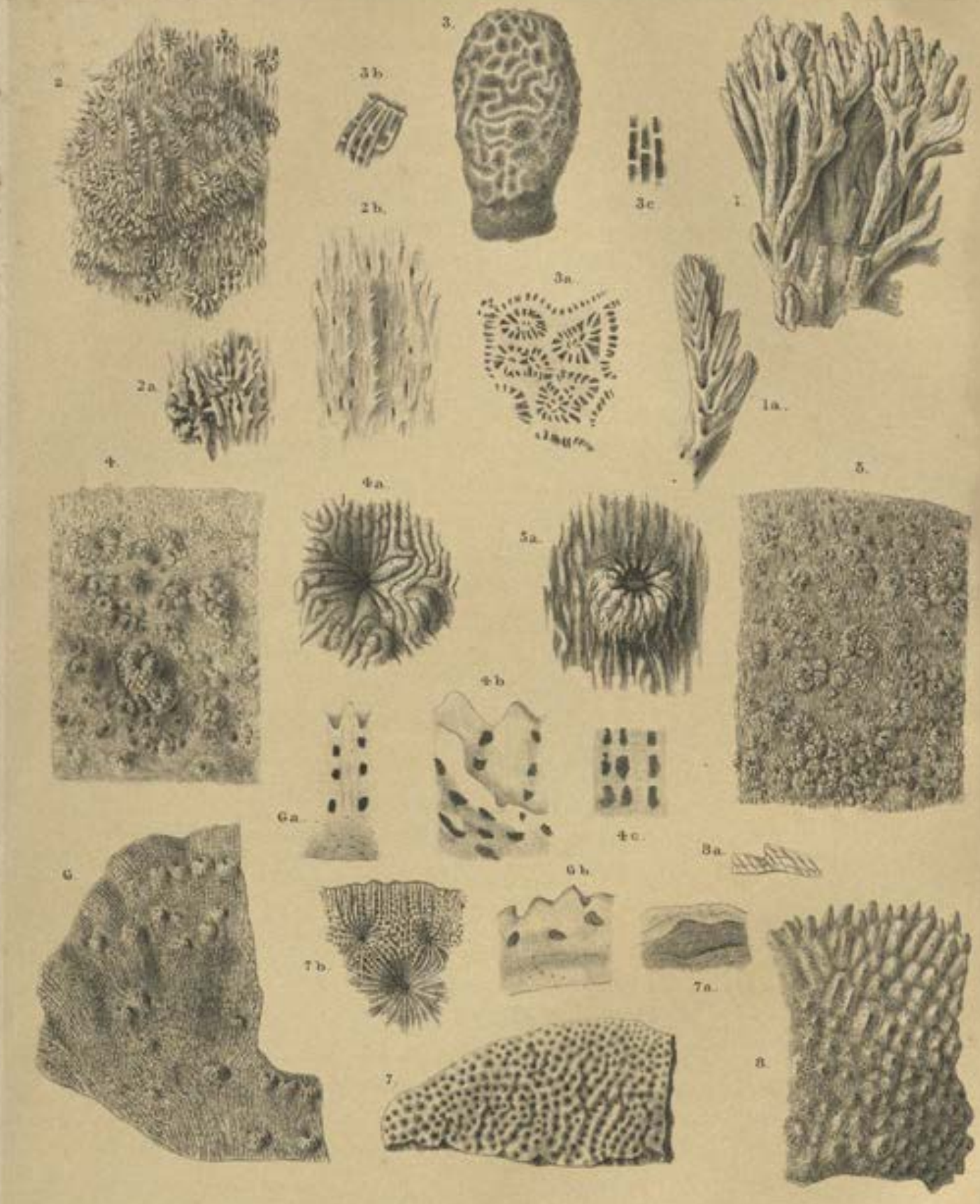
Fig. 6a. A magnified view of a vertical section of the corallum, transverse to the direction of the septo-costæ.
Fig. 6b. A magnified view of a vertical section of the corallum, parallel to the direction of the septo-costæ.

Fig. 7. *Agaricia regularis*, a part of the corallum ; natural size.

Fig. 7a. The under surface of the corallum, with sub-concentric ridges.
Fig. 7b. The marginal part of the corallum ; magnified.

Fig. 8. *Hydnophora tenella*, a part of the corallum ; natural size.

Fig. 8a. A transverse section showing the thinness of the corallum.



A. Gawan del. et lith. Mintern Bros. imp.

1. MERULINA PROLIFERA. 2. OXYPORA CONTORTA. 3. TICHOSERIS OBTUSATA. 4. DOMOSERIS POROSA. 5. D. SOLIDA. 6. D. REGULARIS. 7. AGARICIA REGULARIS. 8. HYDNOPHORA TENELLA.

PLATE VI.

PLATE VI.

Fig. 1. *Fungia tenuidens*, the upper surface of the corallum; natural size.

Fig. 1a. A portion of the under surface; natural size.

Fig. 2. *Fungia rugosa*, a part of the upper surface; natural size.

Fig. 2a. A part of the under surface; natural size.

Fig. 3. *Cycloseris discus*, the upper surface of the corallum; natural size.

Fig. 3a. The under surface; natural size.

Fig. 4. *Cyclloseris incrustans*, the corallum; natural size.

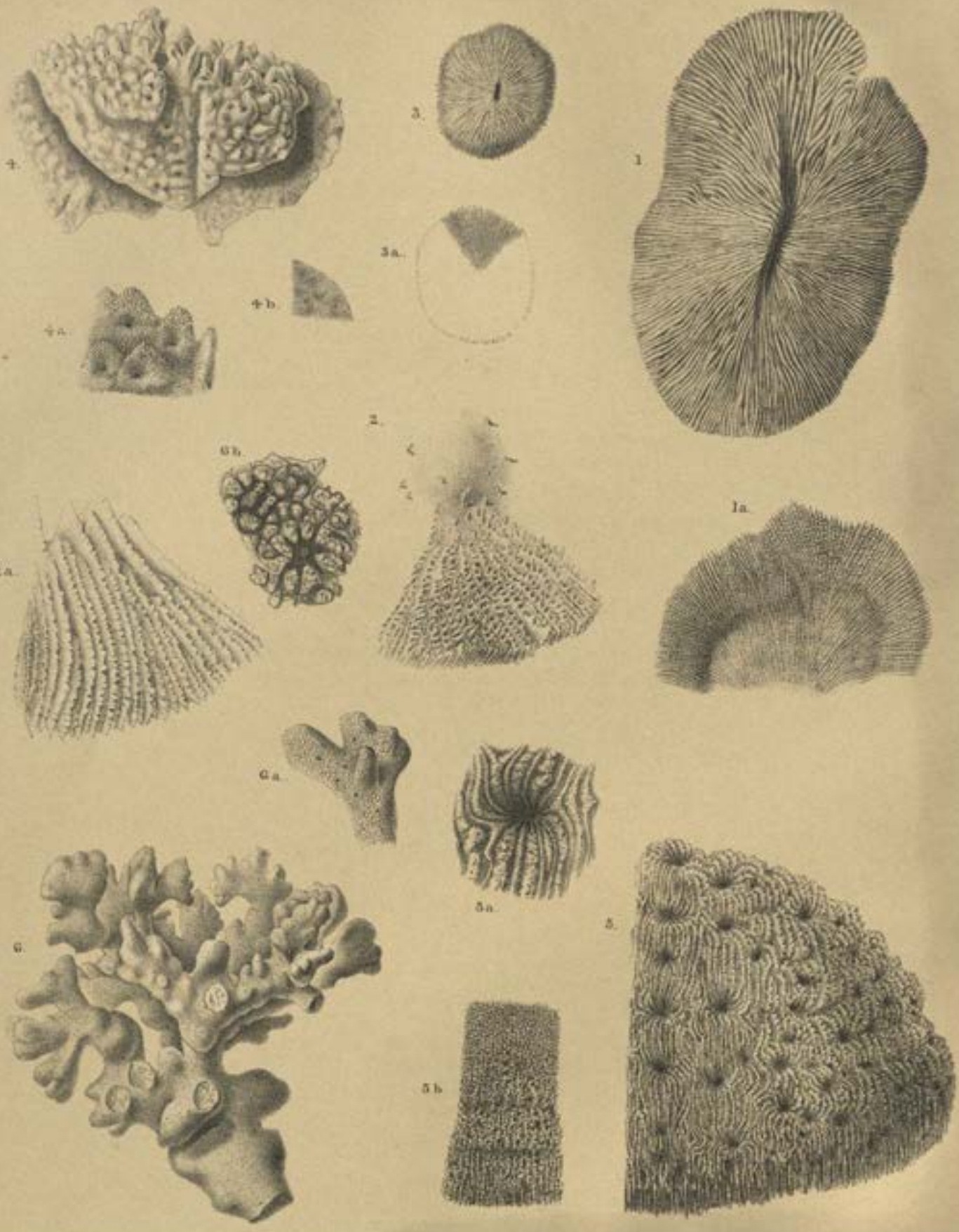
Fig. 4*a*. A part of the corallum; magnified.
Fig. 4*b*. A part of the under surface.

Fig. 5. *Podabacia robusta*, a part of the corallum; natural size.

Fig. 5*a*. A calicle; magnified.
Fig. 5*b*. A marginal part of the under surface.

Fig. 6. *Psammocora ramosa*, a part of the corallum; natural size.

Fig. 6*a*. A branchlet; magnified.
Fig. 6*b*. A part of the surface; more highly magnified.



A. Gawan. del et lith. Mintern Bros. imp.

1. FUNGIA TENUIDENS. 2. F. RUGOSA. 3. CYCLOSERIS DISCUS
4. CYLLOSERIS INCRUSTANS. 5. PODABACIA ROBUSTA. 6. PSAMMOCORA RAMOSA.

PLATE VII.

PLATE VII.

Fig. 1. *Sandalolitha dentata*, the corallum ; natural size.

Fig. 1a. A part of the under surface ; natural size.
Fig. 1b. A part of the under surface ; magnified.
Fig. 1c. Teeth of the septa ; magnified.
Fig. 1d. View of a part of the corallum, showing an early stage in the development of a young calicle.

Fig. 2. *Dendrophyllia conferta*, a part of the corallum ; natural size.

Fig. 2a. Oblique view of a typical calicle, with buds.
Fig. 2b. A calicle, seen from above.

Fig. 3. *Turbinaria æqualis*, a part of the corallum ; natural size.

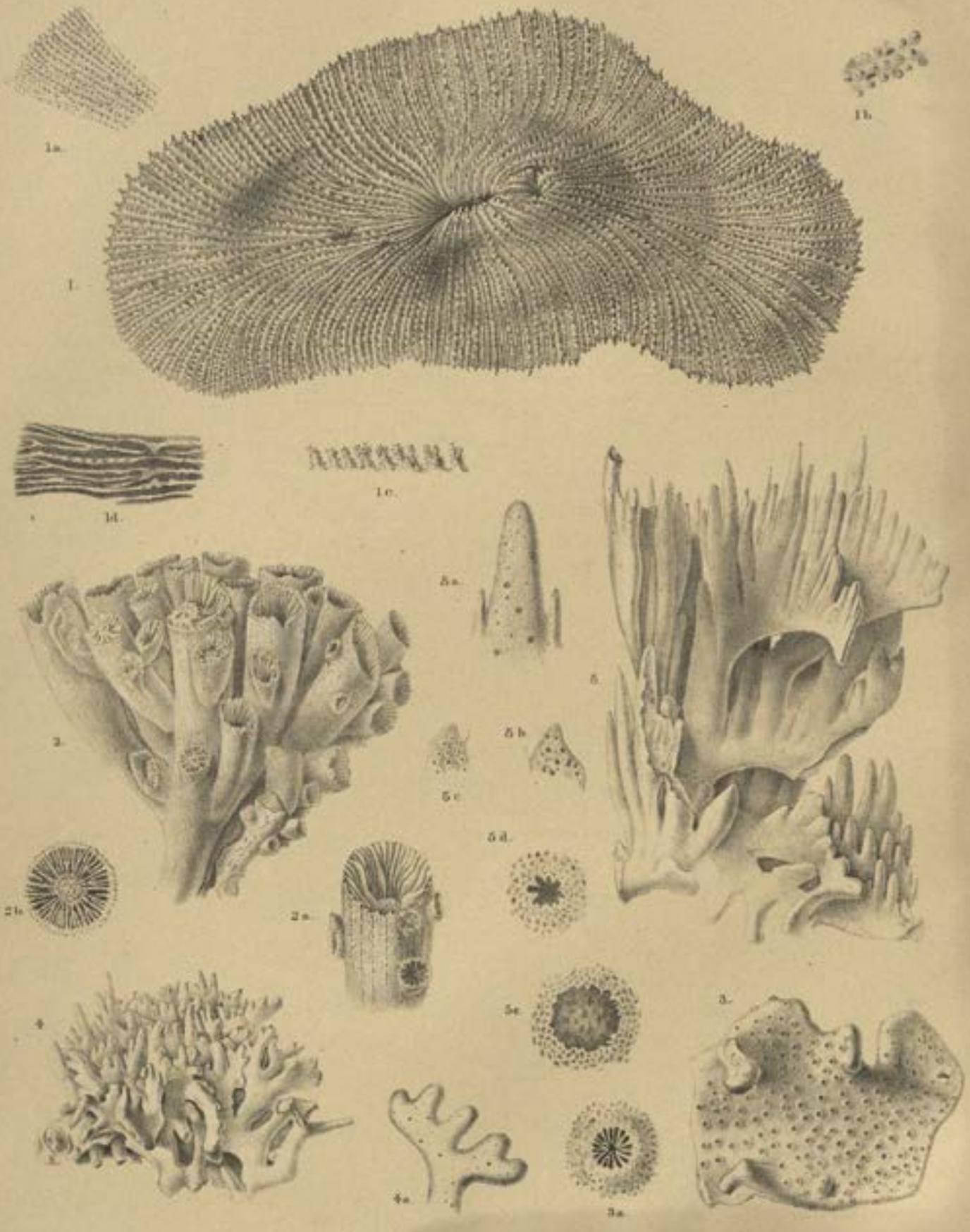
Fig. 3a. A calicle ; magnified.

Fig. 4. *Millepora confertissima*, a part of the cœnosteum ; natural size.

Fig. 4a. A branchlet ; magnified.

Fig. 5. *Millepora murrayi*, a part of the cœnosteum ; natural size.

Fig. 5a. A part of the surface ; magnified.
Fig. 5b. A branchlet with ampullæ ; abraded.
Fig. 5c. A branchlet with ampullæ ; not abraded.
Fig. 5d. An ampulla, as seen in "5c" ; magnified.
Fig. 5e. An ampulla, as seen in "5b" ; magnified.



1. SANDALOLITHA DENTATA. 2. DENDROPHYLLIA CONFERTA. 3. TURBINARIA ÆQUALIS.
4. MILLEPORA CONFERTISSIMA. 5. M. MURRAYI.

PLATE VIII.

PLATE VIII.

Fig. 1. *Montipora fragilis*, a part of the corallum; natural size.

Fig. 1*a*. A calicle with papillæ; magnified.

Fig. 1*b*. Papillæ of the distal surface; magnified.

Fig. 2. *Montipora levis*, a part of the corallum; natural size.

Fig. 2*a*. A calicle; magnified.

Fig. 3. *Montipora obtusata*, the corallum; natural size.

Fig. 3*a*. A calicle; magnified.

Fig. 4. *Montipora irregularis*, a part of the corallum; natural size.

Fig. 4*a*. The wall and calicles; magnified.

Fig. 5. *Montipora exserta*, a part of the corallum; natural size.

Fig. 5*a*. A calicle; magnified.

Fig. 5*b*. Oblique view of a calicle; more highly magnified.

Fig. 6. *Napopora irregularis*, a part of the corallum; natural size.

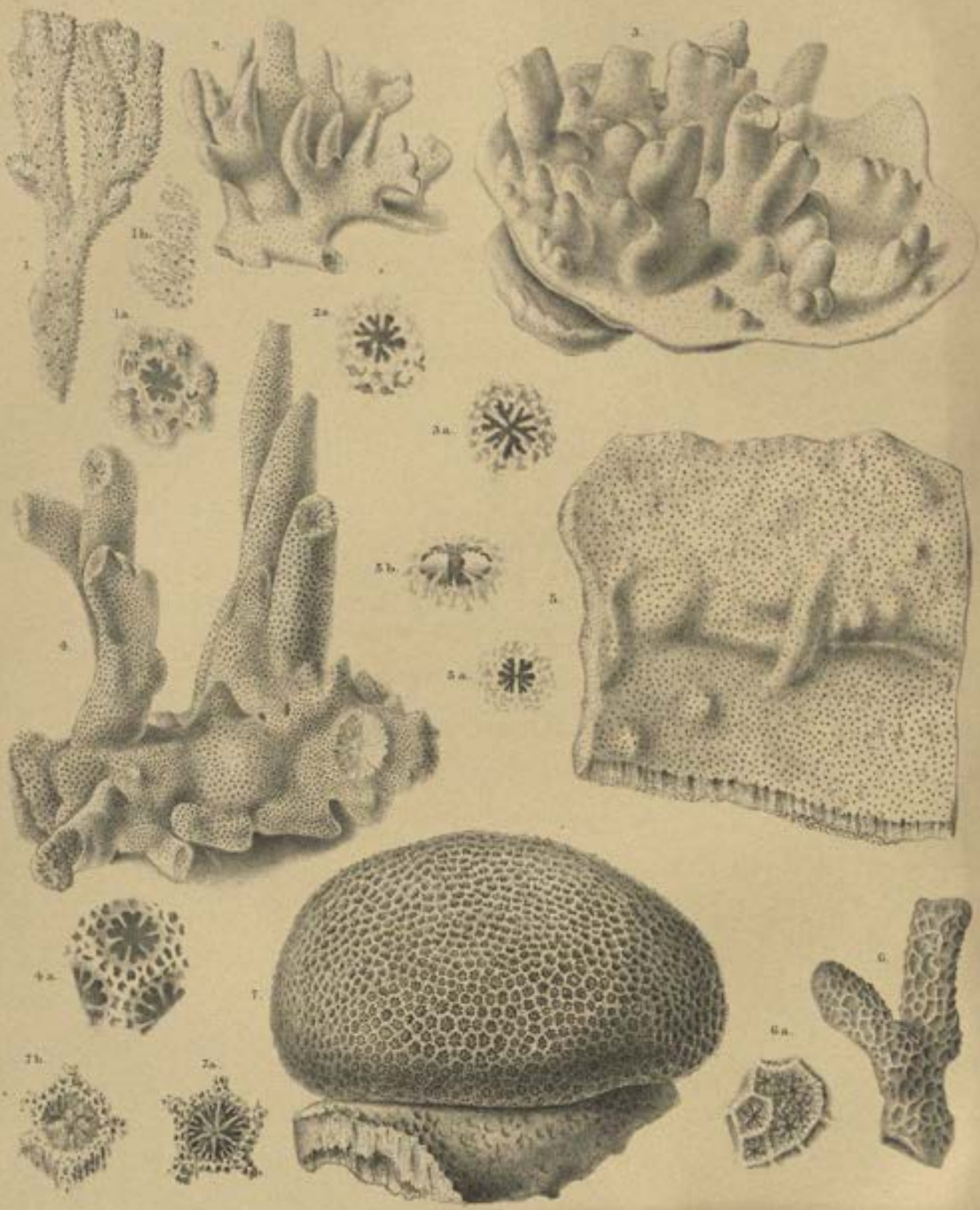
Fig. 6*a*. Calicles; magnified.

Fig. 7. *Rhodarœa*[1] *tenuidens*, the corallum; natural size.

Fig. 7*a*. A calicle; magnified.

Fig. 7*b*. Oblique view of a calicle; magnified.

[1] Not *Rhodarrhœa* as on the Plate.



1. MONTIPORA FRAGILIS. 2. M. LEVIS. 3. M. OBTUSATA. 4. M. IRREGULARIS.
5. M. EXSERTA. 6. NAPOPORA IRREGULARIS. 7. RHODARRHŒA TENUIDENS.

PLATE IX.

PLATE IX.

Fig. 1. *Madrepora manni*, a part of the corallum; natural size.

Fig. 1a. Lateral calicles; magnified.

Fig. 2. *Madrepora canalis*, a part of the corallum; natural size.

Fig. 2a. Lateral calicle; magnified.

Fig. 2b. Oblique view of a lateral calicle; magnified.

Fig. 3. *Madrepora parilis*, a part of the upper surface of the corallum; natural size.

Fig. 3a. A part of the under surface; natural size.

Fig. 3b. A lateral calicle; magnified (the striations on the surface of the calicles are usually much thinner and closer than is shown in the figure).

Fig. 4. *Madrepora minima*, a part of the corallum; natural size.

Fig. 4a. Calicles; magnified.

Fig. 5. *Madrepora angulata*, a part of the corallum; natural size.

Fig. 5a. Calicles; magnified.

Fig. 6. *Madrepora confraga*, a part of the corallum; natural size.

Fig. 6a. A calicle; magnified.

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1. MADREPORA MANNI. 2. M. CANALIS. 3. M. PARILIS.
4. M. MINIMA. 5. M. ANGULATA. 6. M. CONFRAGA.

PLATE X.

PLATE X.

Fig. 1. *Madrepora speciosa*, an upper marginal part of the corallum, viewed obliquely; natural size.

Fig. 1a. An under marginal part of the corallum; natural size.
Fig. 1b. A cluster of calicles; natural size.

Fig. 2. *Madrepora scabrosa*, the upper part of a branch; natural size.

Figs. 2a, 2b, 2c, 2d. Different forms of lateral calicles; magnified.
Fig. 2e. A circular calicle; magnified.

Fig. 3. *Madrepora conferta*, a part of the corallum; natural size.

Fig. 3a. Lateral view of a branchlet; magnified.
Fig. 3b. Lateral calicles, seen laterally; magnified.
Fig. 3c. A branchlet, seen from above; magnified.

Fig. 4. *Madrepora vastula*, a part of the corallum; natural size.

Fig. 4a. Lateral view of a branchlet; magnified.
Figs. 4b, 4c. Lateral calicles, seen laterally; magnified.

Fig. 5. *Madrepora mirabilis*, a part of the corallum; natural size.

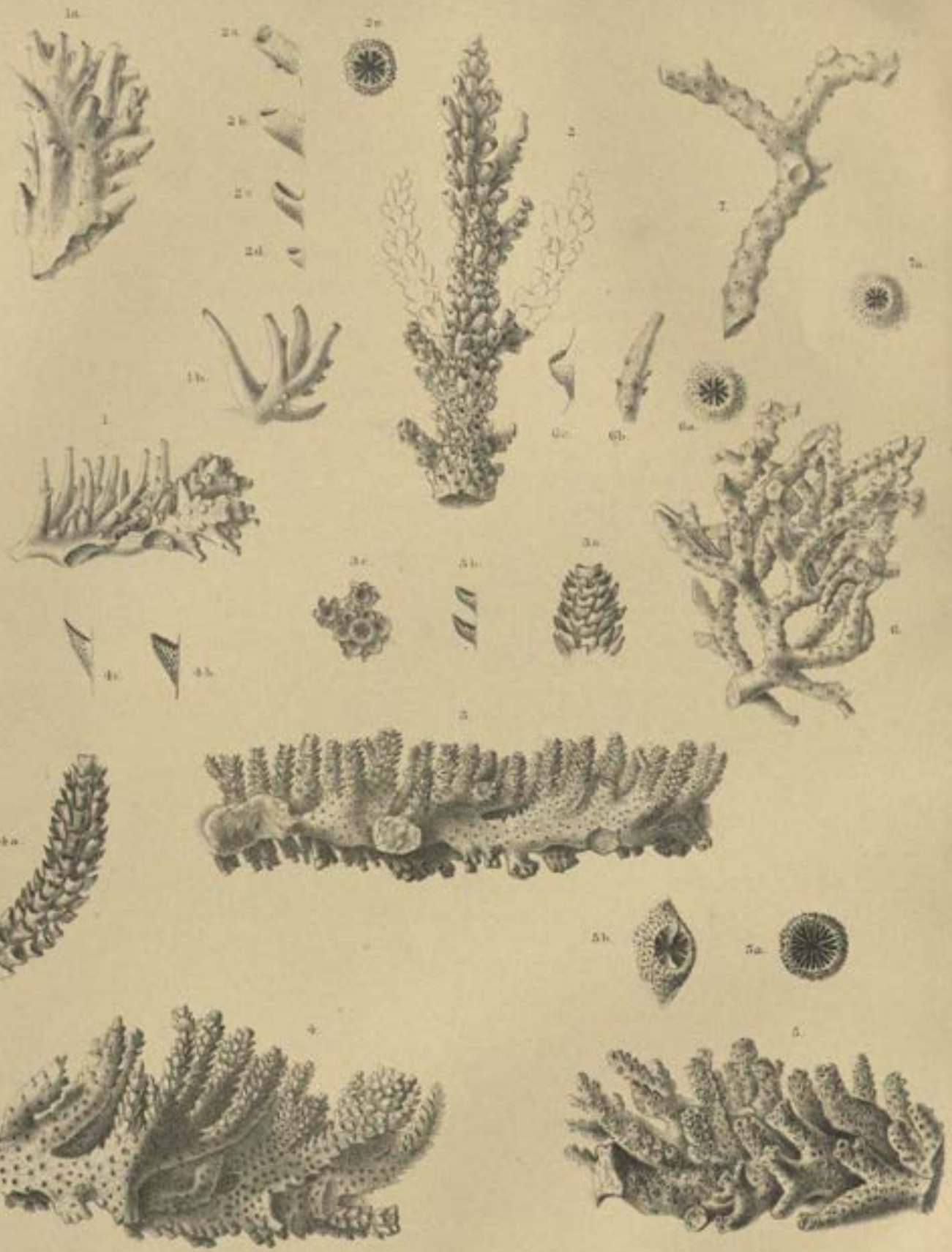
Fig. 5a. A terminal calicle, with three complete cycles of septa; magnified.
Fig. 5b. A lateral calicle, with two exserted septa; magnified.

Fig. 6. *Anacropora gracilis*, a part of the corallum; natural size.

Fig. 6a. A calicle; magnified (the septa are usually less distinct than is shown in the figure).
Fig. 6b. An apex of a branchlet, with the terminal mass of coenenchyma.
Fig. 6c. A lateral view of a calicle; magnified.

Fig. 7. *Anacropora solida*, a part of the corallum; natural size.

Fig. 7a. A calicle; magnified (the septa are usually less distinct than is shown in the figure).



A. Garner, del. et lith. Mintern Bros. imp.

1. MADREPORA SPECIOSA. 2. M. SCABROSA. 3. M. CONFERTA. 4. M. VASTULA.
5. M. MIRABILIS. 6. ANACROPORA GRACILIS. 7. A. SOLIDA.

PLATE XI.

PLATE XI.

Fig. 1. *Tichopora tenella*, lateral view of the corallum; natural size. With vertical section.

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Fig. 2. *Porites crassa*, lateral view of the corallum; natural size.

Fig. 2a. The wall and calicles; magnified.

Fig. 3. *Porites explanata*, the corallum; natural size. Viewed from above.

Fig. 3a. A calicle with the walls; magnified.

Fig. 4. *Porites crassistellata*, lateral view of the corallum; natural size.

Fig. 4a. The wall and calicles; magnified.

Fig. 5. *Porites mirabilis*, lateral view of the corallum; natural size.

Fig. 5a. Large and small calicles; magnified.

Fig. 6. *Porites latistellata*, a part of the corallum; natural size.

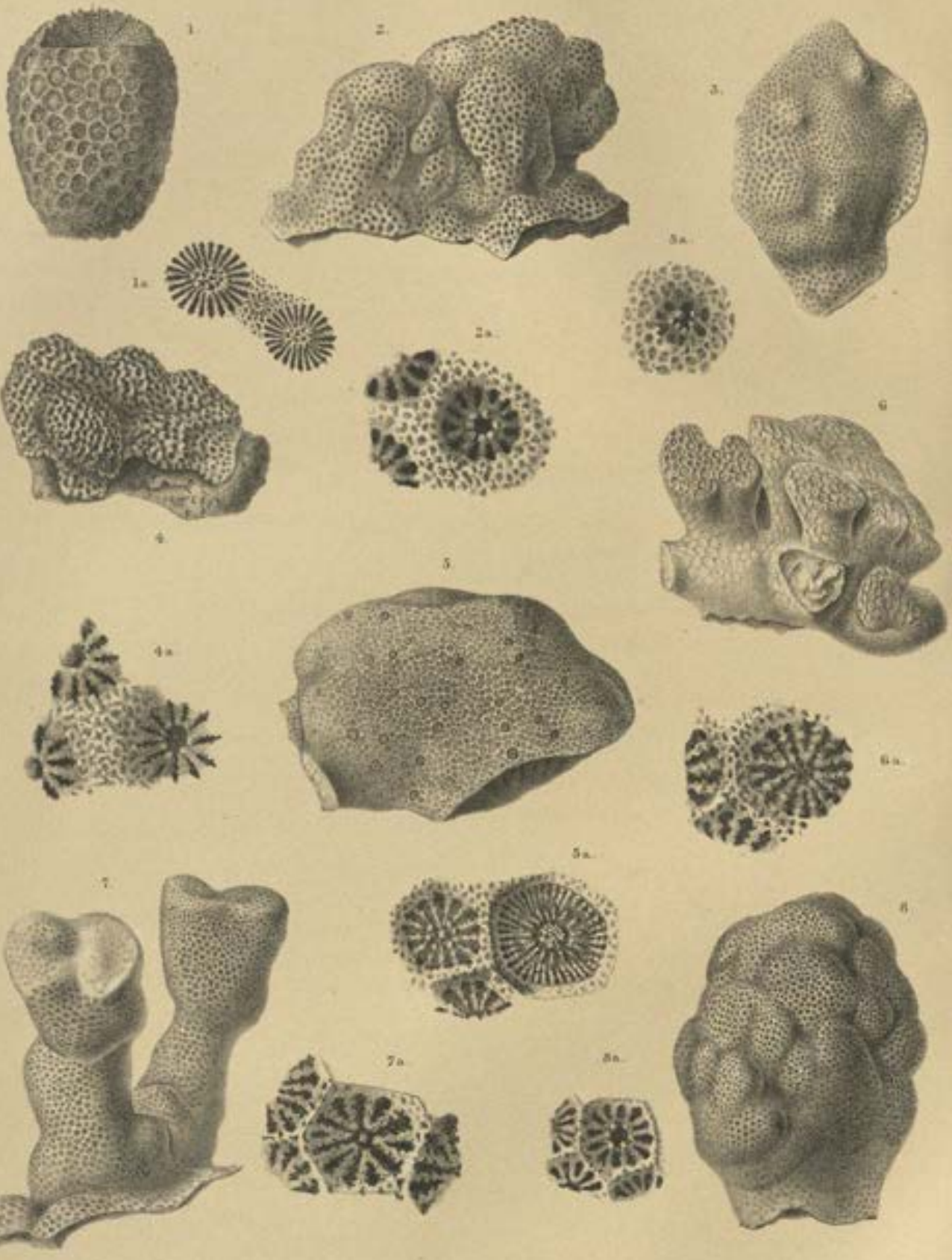
Fig. 6a. The wall and calicles; magnified.

Fig. 7. *Porites bulbosa*, a part of the corallum; natural size.

Fig. 7a. The wall and calicles; magnified.

Fig. 8. *Porites parvistellata*, lateral view of the corallum; natural size.

Fig. 8a. The wall and calicles; magnified.



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1. TICHOPORA TENELLA. 2. PORITES CRASSA. 3. P. EXPLANATA. 4. P. CRASSISTELLATA. 5. P. MIRABILIS. 6. P. LATISTELLATA. 7. P. BULBOSA. 8. P. PARVISTELLATA.

PLATE XII.

PLATE XII.

Fig. 1. *Moseleya latistellata*, the corallum; natural size.

Fig. 2. *Moseleya latistellata*, showing the superposition of one primary calicle above another, with a small, developing, superposed calicle.

Fig. 3. *Moseleya latistellata*, a transverse section, showing the tabula and concentric and subconcentric dissepiments.

Fig. 4. *Moseleya latistellata*, a basal view of the primary calicle of the colony, showing the septa meeting at a point, and the sub-infundibuliform tabula (the central portion of the lower tabula has been removed to show the one above it).

Fig. 5. *Moseleya latistellata*, a small calicle which has developed on the basal, primary calicle.

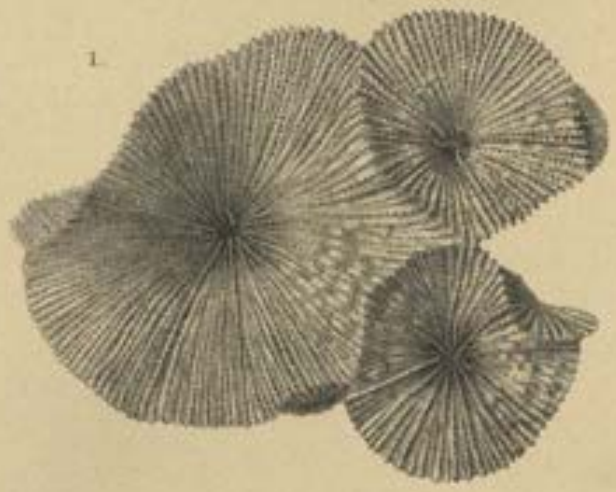
Fig. 6. *Moseleya latistellata*, a part of a vertical section across two calicles, showing the abundant, vesiculate endotheca, and the very slight development of the inner wall.

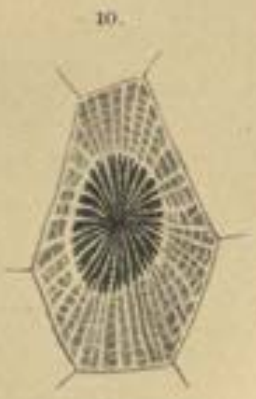
Fig. 7. A diagrammatic representation, on a large scale, of a vertical section, to illustrate the relation of the tabulæ in *Moseleya*, and their probable derivation from the dissepiments.

Fig. 8. A slightly enlarged, inner calicle of *Strombodes murchisoni* (after Milne-Edwards and Haime).

Fig. 9. Calicles of *Cyathophyllum regium* (after Milne-Edwards and Haime).

Fig. 10. A transverse section of a calicle of *Cyathophyllum marmini* (after Milne-Edwards and Haime).





A. Duncan, del. et lith. Mintern Bros. imp.

1–7. MOSELEYA LATISTELLATA. 8. STROMBODES MURCHISONI.
9. CYATHOPHYLLUM REGIUM. 10. C. MARMINI.

THE

VOYAGE OF H.M.S. CHALLENGER.

ZOOLOGY.

REPORT on the HUMAN CRANIA AND OTHER BONES OF THE SKELETONS collected during the Voyage of H.M.S. Challenger, in the Years 1873-76. By Sir WILLIAM TURNER, Knt., M.B., LL.D., F.R.SS. L. & E., Professor of Anatomy in the University of Edinburgh, Foreign Member of the Anthropological Society of Paris.

PART II.—THE BONES OF THE SKELETON.

THE Crania having been described in the First Part of this Report (Zool. Chall. Exp., part xxix., 1884), I shall now proceed to the consideration of the characters of the other bones of the skeleton. In my inquiries into this division of the subject, as in the study of the crania, I have not restricted myself to the examination of the bones brought home by the Challenger. I have also studied a valuable series of human skeletons of various races, some of which have been for a long period in the Anatomical Museum of the University of Edinburgh, having been collected by my predecessors in the Chair of Anatomy, Professors Alexander Monro *tertius* and John Goodsir, whilst others have been obtained by myself during the last twenty years.

In the course of this inquiry I have also consulted the previous literature on the same subject, so far as I have had access to it, and have endeavoured, as far as the material at my command would admit, to make this part of the Report an essay on the Comparative Osteology of those Races of Men whose bones are described in this Report.

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BONES OF THE HUMAN SKELETON.

PELVIS.

Introduction.

Anatomists have long recognised that marked sexual differences exist in the male and female pelvis, and obstetricians have carefully studied this part of the skeleton in women in its relations to the mechanism of parturition. Numerous measurements, more especially of the cavity of the pelvis, with its brim and outlet, in the principal European races, have been recorded by observers in their respective countries, so that the normal form, size, and proportions of the pelvis in these races have been satisfactorily ascertained. Some isolated observations on the form and dimensions of the pelvis in non-European races were also made at the end of the last century and the beginning of the present. P. Camper pointed out[1] in 1785 some differences which existed between the subpubic angle of a woman from Celebes and a Negro as compared with the European. Von Sömmerring in the same year[2] published some remarks on the characters of the pelvis in the Negro. In 1797 M. Rollin[3] observed that the pelvis in the Indian women near the Baie des Français, north-west America, was characterised by its large diameters. In 1817 Cuvier described[4] the pelvis of the so-called Hottentot Venus.

The publication by Vrolik in 1826 of an important memoir on the diversities of the pelvis in the different races of men gave a new impetus to the study of this branch of anatomy, and since that time numerous valuable memoirs on the race characters of the pelvis have appeared, the most important of which are named in the following list :—

Vrolik, G., Considérations sur la Diversité des Bassins de différentes races humaines, 1826. Beschouwing van het verschil der bekkens in onderscheidene volkstammen, Amsterdam, 1826. Also Musée Vrolik; Catalogue par J. L. Dusseau, Amsterdam, 1865.

Weber, M. J., Die Lehre von den Ur- und Rassen-formen der Schädel und Becken des Menschen, Düsseldorf, 1830; and previously in v. Gräfe u. v. Walther's Journ. der Chirurgie, 1823.

[1] *Verhandlingen der Bataafsch Genootschap te Rotterdam*, Bd. i.

[2] Körperliche Verschiedenheit des Negers vom Europäer, Frankfurt und Mainz, 1785.

[3] Voyage de la Pérouse autour du Monde, publié by Milet Mureau, t. iv., 1797.

[4] *Mémoires du Muscum d'Histoire naturelle*, t. iii., 1817.

MÜLLER, J., Ueber die äusseren Geschlechtstheile der Buschmänninnen. (The pelvis is described.) *Archiv f. Anat. u. Physiol.*, 1834, S. 332.

KILIAN, Geburtshülflicher Atlas, Düsseldorf, 1835.

BUSCH, Handbuch der theoretischen und praktischen Geburtskunde, 1838.

STEIN, Ueber die Meinung von Racenverschiedenheiten der Becken, *Neue Zeitschr. f. Geburtskunde*, Bd. xv., 1844, and previously in Lehre der Geburtshülfe, 1825.

BURMEISTER, H., The Black Man, New York, 1853.

STRUTHERS, J., Description of an Esquimaux Female Pelvis, Anatomical and Physiological Observations, Edinburgh, 1854.

OWEN, R., Descr. Cat. Osteological Series, Mus. Roy. Coll. Surg. London, 1858.

HUMPHRY, G. M., The Human Skeleton, Cambridge, 1858.

WOOD, JOHN, article Pelvis in *Todd's Cyclop. of Anat. and Phys.*, vol. v., London, 1859.

LITZMANN, C. C. T., Die Formen des Beckens. Berlin, 1861.

ECKER, Zur Kenntniss der Eingeborenen Süd-Australiens, *Berichte d. naturf. Ges. z. Freiburg*, 1861.

BOURGAREL, A., Des races de l'Océanie française, *Mém. de la Soc. d'Anthrop. de Paris*, t. i., 1861.

ZAALBERG, T., Beschrijving van twee vrouwenbekkens uit den Ost-Indischen Archipel, Academisch proefschrift, Leiden, 1862. Untersuchungen ueber die Form des Beckens Javanischen Frauen, *Holländische Gesellschaft der Wissensch. zu Haarlem*, D. xxiv., 1866.

WYMAN, J., Observations on the Skeleton of a Hottentot, *Proc. Boston Soc. Nat. Hist.*, April 2, 1862, and December 16, 1863; also *Anthropological Review*, vol. iii., 1865.

JOULIN, Du bassin considéré dans les races humaines, *Archives générales de Médecine*, July 1864.

PRUNER-BEY, Étude sur le bassin considéré dans les differ. races humaines, *Bull. Soc. Anthrop. de Paris*, 1864.

KEFERSTEIN, W., Bemerkungen über das Skelett eines Australier von Stamme Warnambool. Dresden, 1865.

HUXLEY, T. H., Notes on the Human Remains in Laing's Prehistoric Remains of Caithness, London, 1866.

WEISBACH, A., Die Becken Österreichischer Völker, *Zeitschr. d. Gesellsch. der Aerzte, Wien*, Bd. i., 1866. *Schmidt's Jahrbücher*, 1866, Bd. cxxxii. Körpermessungen verschiedener Menschenrassen, Berlin, 1878.

MARTIN, CARL, Beckenmessung an verschiedener Menschenrassen, *Monatsch. für Geburtskunde*, xxviii., 1866, S. 23. *Corresp.-Blatt der deutsch. Gesellsch. f. Anthr. Ethn. u. Urgesch.*, März 1881, N. 3, S. 22, 23.

WEST, J. VAN, Twee Indiaansche bekkens uit de Kolonie Suriname.

DAVIS, J. BARNARD, Thesaurus Craniorum, 1867; Supplement, 1875. The Osteology and Peculiarities of the Tasmanians, *Natuurk. verhand. van de Holland. Maatsch. der Wetensch.*, Deel ii., 1874.

HOLST, *Beiträge zur Gynäkologie*, Bd. ii., 1867.

GÖRTZ, KARL, Ueber das Becken eines Buschweibes. *Inaugural Dissertation*, Tübingen, 1868. *Anthropological Review*, vol. iii., 1870.

FRANQUE, O. VON, Ueber das weibliche Becken verschiedener Menschenrassen, *Scanzoni's Beiträge zur Geburtskunde und Gynäkologie*, Bd. vi., Würzburg, 1869.

FRITSCH, GUSTAV, Die Eingeborenen Süd-Afrikas, Breslau, 1872.

BACARISSE, Du sacrum suivant le sexe et suivant les races. *Thèse inaugurale*, Paris, 1873.

FRITSCH, H., Nonnulla de pelvibus specierum humanorum, Halle, 1873. Das Rassenbecken und seine Messung, *Mittheil. des Vereins für Erdkunde zu Halle*, 1878, S. 18.

VERNEAU, R., Le Bassin dans les Sexes et dans les Races, Paris, 1875.

TOPINARD, P., Des proportions générales du Bassin chez l'homme et dans la série des Mammifères, *Bull. Soc. Anthrop. de Paris*, 1875. Éléments d'Anthropologie Générale, Paris, 1885.

HENNIG, C., Tabellen von Racenbecken in Verhandl. der Versamml. deutschen Gynäkologen in München in *Archiv für Gynäkol.*, Bd. xii. S. 273, 1877; also *Mittheil. d. Gesellsch. f. Geburtshülfe zu Leipzig*, Bd. xxx., Leipzig, 1878; *Bericht der Naturforsch. Gesellsch. zu Leipzig*, 1881.

WERNICH, Ueber Becken- und Entbindungsverhältnisse ostasiatischer Völker, Verhandl. der Versamml. deutscher Gynäkologen in München in *Archiv für Gynäkol.*, Bd. xii. S. 288, 1877.

WINCKEL, F., Einiges über die Beckenknochen und die Becken der Papuas, *Mittheil. aus dem zoolog. Museum zu Dresden*, Heft. i., 1877.

FILATOFF, A., Die weibliche Becken russischer Volkstämme, Moscow, 1877, referred to in *Schmidt's Jahrbuch.*, 1878, S. 210, Bd. clxxviii. Abstract by C. Hennig.

BROCA, PAUL, Squelettes de deux Hindous noirs des environs de Madras, *Bulletin de la Soc. d'Anthrop. de Paris*, t. 1, ser. 3, p. 47, 1878.

MEYER, A. B., and E. TÖPFEL, Verzeichniss der Race-skelete und Schädel des Dresdner Anthropologischen Museums, *Mittheil. aus dem k. zoologischen Museum zu Dresden*, 1878.

MAUREL, Sur un Bassin de femme Coolie. *Bull. Soc. Anthrop. de Paris*, 1879.

FLOWER, W. H., Osteology and Affinities of the Natives of the Andaman Islands, *Journ. of the Anthrop. Institute*, November 1879. Additional Observations, *Ibid.*, November 1884.

SCHVENCK, A. v., Untersuch. über das Becken der Esten, *Studien über Schwangerschaft*, &c., Dorpat, 1880.

GARSON, J. G., Pelvimetry, *Trans. International Medical Congress*, vol. i. p. 185, 1881; and *Journ. Anat. and Phys.*, October 1881. On the osteological characters of the Kubus of Sumatra, *Journ. Anthrop. Inst.*, vol. xiv. p. 128, 1885. On the inhabitants of Tierra del Fuego, *Journ. Anthrop. Inst.*, vol. xv., 1885.

COHVE, A., La mère et l'enfant dans les races humaines, Paris, 1882.

ROHLFS, H., *Deutsches Archiv für Geschichte der Medicin*, v., 1882.

PROCHOWNICK, L., Ueber Beckenneigung, *Archiv f. Gynäkol.*, Bd. xix. Heft. i.; and Mittheil. über Anthropol. Beckenmessung, *Cor. Blatt. deutsch. Ges. für Anthrop.*, June 1881.

PLOSS, H., Zur Verständigung über ein gemeinsames Verfahren zur Beckenmessung, *Archiv für Anthrop.*, Heft. iii. Bd. xv. S. 259, 1884.

TURNER, W., The Index of the Pelvic Brim as a Basis of Classification, *Journ. of Anat. and Phys.*, October 1885. The Sacral Index in various Races of Mankind, *Proc. Roy. Soc. Edin.*, December 7, 1885; and *Journ. of Anat. and Phys.*, January 1886.

The numerous tables of pelvic measurements which have been published by various writers on this part of the skeleton, show a certain want of uniformity in the measures adopted. There is indeed a general accordance of opinion on the necessity of taking the greatest height and the greatest transverse breadth of the entire pelvis, of measuring the antero-posterior and the transverse diameters of both the brim and the outlet of the true pelvis, and of determining the length and breadth of the sacrum. But as regards other dimensions much diversity of practice exists, for a greater importance has been attached to the estimation of the distance between certain points by some writers than by others.

M. Verneau[1] has employed no fewer that fifty measurements in his comparative study of the human pelvis, and has in addition estimated the relation between the greatest antero-posterior and transverse diameters, the height and the greatest transverse diameter, and the conjugate and transverse diameters of the brim. On the other hand, Gustaf Fritsch[2] and J. G. Garson[3] in their respective memoirs have not considered it necessary to take more than fourteen measurements, from which various indices have been deduced. It seems to me that several of those employed by Verneau are unnecessary, and throw but little light on those characters which are to be regarded as of primary or even secondary importance in the study of the pelvis in the different races of men. The dimensions taken by G. Fritsch and by Garson, again, although these observers do

[1] Le Bassin dans les Sexes et dans les Races, 1875.

[2] Die Eingeborenen Süd-Afrikas.

[3] Pelvimetry in *Journ. Anat. and Phys.*, October 1881.

not in all cases measure between the same points of the pelvis, are in my judgment too few, and do not sufficiently bring out all the characters which require attention.

I have employed, therefore, a larger number than these last-named observers, though not so many as M. Verneau, and have arranged them under the three following heads:—A. External Dimensions; B. Dimensions of the Cavity; C. Dimensions of the Individual Bones. The measurements are recorded in millimètres. All the dimensions of the non-European pelves and of the Laplanders have been taken on macerated and dried specimens, the majority of which were articulated under my direction by my museum assistant, Mr. James Simpson. Into each sacro-iliac joint a thin piece of wash-leather was introduced to represent the substance of the sacro-iliac cartilages, and the pubic symphysis was filled in by folds of leather approximating in thickness to the corresponding cartilage.[1]

A. *External Dimensions of Pelvis.*

1. Breadth of pelvis is the greatest diameter between the outer lips of the iliac crests.

2. Height of pelvis, *i.e.*, height of innominate bone, or ischio-iliac diameter, is from the summit of the iliac crest to the most depending part of the tuber ischii.

3. *Breadth-height index* is the relation of the maximum breadth and height of the entire pelvis to each other, and is computed by the formula[2] $\frac{\text{height} \times 100}{\text{breadth}}$.

4. Breadth between anterior superior iliac spines is, as is customary with obstetricians, the greatest breadth between the outer lips of these spines.

5. Breadth between posterior superior iliac spines. The postero-superior spine varies in arrangement in different pelves. Sometimes it is fused with the roughened posterior part of the crest, which gives attachment to the gluteus maximus, and forms the free posterior end of that surface; in others this spine is separated from that surface by a depression, and forms a distinct tubercle to its inner and posterior part. The callipers are placed in either case on the spine close to its inner border.

6. Breadth between ischial tubera is the greatest distance between their outer borders.

7. Breadth between ischial spines is between their tips, but as these were frequently broken this measurement could only sometimes be made.

8. Greatest diameter of cotyloid is between opposite points of the margin of this cavity. As a rule there is not more than from 1 to 2 mm. difference between the

[1] It is possible that in a few specimens the transverse diameter may have been increased a little beyond the normal by the interposed leather being somewhat thicker than the natural cartilage.

[2] In calculating this and the other indices, when the fraction was below 0·5 I have not taken it into account. When 0·5 or above 0·5 I have either stated it or given the benefit of the fraction to the preceding whole number.

vertical and transverse diameters of the cotyloid at its brim, and more usually the vertical is a little greater than the transverse; the letters *v.* and *t.* in the tables express the diameter which prevailed in each pelvis. In this and in the measurements of the obturator foramen the right innominate bone was selected.

9 and 10 are the greatest diameters of the obturator foramen in the vertical and transverse directions.

11. *Obturator index* expresses the relative height and width of this foramen, and is obtained by the formula $\frac{\text{transverse d.} \times 100}{\text{vertical d.}}$.

12. Subpubic angle is taken with the useful goniometer devised and figured by Dr. Garson.[1]

B. *Dimensions of Cavity of True Pelvis.*

These dimensions are to be taken at the brim, at the outlet, and in the cavity itself.

13. Transverse diameter is the greatest transverse width between the ilio-pectineal lines.

14. Conjugate or antero-posterior diameter would in a fresh pelvis be taken from the mid-point on the promontory of the sacrum to the back of the upper end of the symphysial cartilage, but in the dried pelvis the posterior surface of the body of the os pubis immediately adjacent to the upper part of the region of the symphysis has been selected. In some pelves the body of the os pubis curves backward a little below the brim, but this projecting part has not been taken as the point on which to place the callipers.

15. *Pelvic* or *Brim index* is the relation of the conjugate diameter to the transverse. It is computed by the formula employed by Professor Zaaijer,[2] $\frac{\text{conj. d.} \times 100}{\text{transverse d.}}$, in which the transverse diameter is regarded as $= 100$.

16. Oblique diameter is the distance between the sacro-iliac joint on the one side, and the ilio-pectineal line on the opposite side of the brim internal to the pectineal eminence. As there is sometimes a want of symmetry in the pelvis, it is necessary that both the right and left oblique diameters should be taken.

17. Inferior sagittal diameter is measured from the middle of the antero-inferior border of the body of the fifth sacral vertebra to the lower border of the pubic symphysis.

18. Coccygeo-pubic diameter from the tip of the coccyx to the lower border of the

[1] Pelvimetry, *Journ. Anat. and Phys.*, vol. xvi. p. 106, pl. v., October 1881.

[2] Untersuchungen ueber die Form des Beckens Javanischer Frauen, *Hollandischen Gesellschaft der Wissensch. zu Haarlem*, Deel xxiv., 1866.

pubic symphysis. As the coccyx was so often broken or absent this measurement could frequently not be taken.

19. Intertuberal diameter between the inner borders of the ischial tuberosities immediately below the small sciatic notch.

20. Depth of pubic symphysis is the distance between its upper and lower borders.

21. Depth of pelvic cavity is the distance between the brim near the pectineal eminence and the most depending part of the ischial tuber.

C. *Dimensions of the Individual Bones.*

In addition to determining the length and breadth of the sacrum and of the coccyx when present, I have taken the length of each of the three elements of the os innominatum. The ilium, ischium, and os pubis, both in man and other mammals, may each be regarded as having the fundamental form of an elongated rod-like bone possessing three surfaces, three borders, and two extremities.[1] The central end of each bone terminates in the acetabulum, where the three bones become, as is well known, fused together. The peripheral end of the ilium is the highest point of the crest, the peripheral end of the os pubis is at the pubic symphysis, the peripheral end of the ischium is the most depending part of the tuber. The actual line of junction of these bones with each other in the acetabulum disappears when the ossification of the os innominatum is completed, but there are certain marks at the bottom of the acetabulum in the adult which indicate with a fair amount of precision the lines where they have become fused together. The junction of the ilium and ischium corresponds almost exactly to the upper border of the non-cartilaginous covered surface, where it forms an angle with the posterior border of the same surface. The junction of the os pubis with the ischium and ilium corresponds with the upper border of this surface opposite the pectineal eminence; a slight notch in this border, or in the margin of the cotyloid, often marks the junction, and I have sometimes seen a shallow furrow extending across the smooth cartilaginous-covered surface immediately above the rough area.

22. Height-length of ilium is measured from the angle formed by the junction of the upper and posterior borders of the rough area at the bottom of the acetabulum to the highest point of the iliac crest.

23. Breadth of ilium is the distance between the antero-superior and postero-superior iliac spines.

[1] See the description of these bones in man in my article Anatomy in the *Encyclopædia Britannica*, ninth edition, 1874, and in my Introduction to Human Anatomy. In the discussion which followed the reading of Dr. Garson's paper on pelvic measurements before the Anatomical Section of the International Medical Congress in 1881, I referred to the importance of the rod-like form of these bones and of expressing their length in tables of pelvic measurements (see *Transactions of Congress*, vol. i. p. 190).

24. *Iliac index* is the relation of the height-length to the breadth of the ilium obtained by the formula $\frac{\text{breadth} \times 100}{\text{height-length}}$.

25. Breadth of innominate bone is from the postero-superior iliac spine to the top of the pubic symphysis.

26. Length of os pubis is from a point at the bottom of the acetabulum, at the upper border of the rough surface opposite the pectineal eminence, to the pubic symphysis.

27. *Pubo-innominate index* is the relation of the length of the os pubis to the breadth of the innominate bone, and is computed by the formula $\frac{\text{pubic length} \times 100}{\text{innominate breadth}}$.

28. Length of ischium is from the angle formed by the junction of the upper and posterior border of the rough area at the bottom of the acetabulum to the most depending part of the tuber ischii.

29. *Innominate index.*—The height-length of the innominate bone being the same as the height of the pelvis (2), the relation of the breadth of the bone to its height is computed by the formula $\frac{\text{breadth} \times 100}{\text{height-length}}$.

30. *Ischio-innominate index* is the relation of the length of the ischium to the height-length of the innominate bone or pelvic height (2), and is computed by the formula $\frac{\text{ischial length} \times 100}{\text{pelvic height}}$.

31. Length of sacrum is from the middle of the promontory to the middle of the antero-inferior border of the *fifth* sacral vertebra.

32. Breadth of sacrum is the greatest breadth of the base of the sacrum.

33. *Sacral index* is computed by the formula $\frac{\text{breadth} \times 100}{\text{length}}$, length = 100.

34. Length of coccyx is the length from the base of the first coccygeal vertebra to the tip of the coccyx.

35. Breadth of coccyx is the greatest breadth of the first coccygeal vertebra. Owing to the coccyx being frequently either imperfect or broken in the macerated pelvis, the dimensions of this bone could only seldom be taken. A coccygeal index might be computed by a formula similar to that used in estimating the sacral index.

Australians.—Table I. Plate I.

I have examined and measured eight Australian pelves, of which six were adult males, one an adult female, and one a young male. They, with one exception, were portions of the skeletons to which the skulls described in the First Part of this Report from Queensland, Riverina, Swan Hill *b*, Table III.; from Eucla, Perth, Table IV.; from West Victoria, Table V.; and from near the Murray River, Table VI., belonged. The additional skeleton, a male from Manly Cove, New South Wales, I have received from Professor Anderson

Stuart of the University of Sydney since the publication of the First Part of this Report. As the number of adult male pelves afforded a fair amount of material for comparison, I shall especially describe their characters.

In three males the bone was very thin in the iliac fossa, in three it was not so. As a rule the bones were heavy and the iliac fossæ looked inwards. The maximum breadth was 278 mm. in the Queensland skeleton, in which the wings of the ilia were more expanded than in the other specimens; the minimum breadth was 232 mm. in the Encla male, and the mean breadth of the six males was 252 mm. The maximum height was 205 mm., the minimum 180 mm., and the mean 194 mm. The mean breadth-height index was 77. The breadth between the antero-superior iliac spines in each pelvis was more than three times as great as that between the postero-superior iliac spines, and in the Manly Cove and Queensland specimens was four times as great. The greatest diameter of the cotyloid ranged from 50 to 55 mm. The mean vertical diameter of the

TABLE I.—AUSTRALIANS.

		Swan Hill. E.U. A.M.	Perth. E.U. A.M.	Encla. E.U. A.M.	Queensland. Chal.	Riverina. E.U. A.M.	Manly Cove. N.S.W. E.U. A.M.	W. Vict. Chal.	Murray River. E.U. A.M. Young
	Sex,	M.	M.	M.	M.	M.	M.	F.	M.
A. External dimensions.	1. Breadth of pelvis,	260	237	232	278	265	249	211	...
	2. Height of pelvis,	198	180	191	205	205	183	161	...
	3. *Breadth-Height Index*,	*76*	*76*	*82*	*74*	*77*	*76*	*76*	...
	4. Between ant. sup. iliac spines,	227	207	205	244	220	210	189	...
	5. Between post. sup. iliac spines,	71	58	64	60	71	51	79	61
	6. Between ischial tubera,	128	116	145	131	141	121	129	111
	7. Between ischial spines,	...	66	...	67	81	65	94	...
	8. Greatest diameter of cotyloid,	54*l*	50*v*	54*v*	55*l*	55*l*	53*el*	44*v*	52*v*
	9. Vertical diameter of obturator foramen,	51	47	52	53	49	51	39	46
	10. Transverse diameter of obturator foramen,	32	33	33	39	31	28	33	28
	11. *Obturator Index*,	*63*	*70*	*63*	*74*	*63*	*55*	*85*	*61*
	12. Subpubic angle,	64°	56°	69°	47°	70°	68°	89°	53°
B. Dimensions of cavity of true pelvis.	13. Transverse diameter of brim,	113	102	105	123	122	98	109	97
	14. Conjugate diameter of brim,	110	101	96	109	105	114	105	91
	15. *Pelvic or Brim Index*,	*97*	*99*	*91*	*89*	*88*	*116*	*96*	*94*
	16. Oblique diameter of brim { Right,	122	103	109	121	110	105	104	99
	16. Oblique diameter of brim { Left,	122	103	105	125	124	105	115	99
	17. Inferior sagittal diameter,	113	90	102	111	102	101	87	83
	18. Coccygeo-pubic diameter,	...	...	...	...	...	94	...	...
	19. Intertuberal diameter,	90	81	97	80	91	74	100	67
	20. Depth of pubic symphysis,	36	37	42	41	38	40	35	34
	21. Depth of pelvic cavity,	97	89	91	100	100	92	71	...
C. Dimensions of individual bones.	22. Height-length of ilium,	122	110	113	116	124	111	100	...
	23. Breadth of ilium,	150	140	147	159	156	145	126	...
	24. *Iliac Index*,	*123*	*127*	*130*	*137*	*126*	*131*	*126*	...
	25. Breadth of innominate bone,	164	140	147	160	156	157	141	135
	26. Length of os pubis,	74	64	64	77	74	63	62	...
	27. *Pubo-innominate Index*,	*45*	*46*	*43·5*	*48*	*47*	*40*	*44*	...
	28. Length of ischium,	88	77	81	95	88	80	64	...
	29. *Innominate Index*,	*53*	*78*	*77*	*78*	*76*	*86*	*88*	...
	30. *Ischio-innominate Index*,	*44*	*43*	*42*	*46*	*40*	*44*	*40*	...
	31. Length of sacrum,	110	104	96	111	105	108	88	88
	32. Breadth of sacrum,	110	97	92	104	111	108	89	89
	33. *Sacral Index*,	*100*	*93*	*96*	*94*	*106*	*100*	*101*	*101*
	34. Length of coccyx,	...	...	...	...	...	35	...	...
	35. Breadth of coccyx,	...	...	...	...	...	40	...	...

obturator foramen in the males was 50·5, the mean transverse 33 mm., and in all these the vertical diameter very considerably exceeded the transverse; the mean obturator index was 65. In the female pelvis these diameters were more nearly equal, and the obturator index was as high as 85. The subpubic angle showed a considerable range of variation in the males, viz., from 47° to 70°, with a mean of 61°·5, and it is somewhat remarkable that the pelvis from Queensland, which was the broadest both in its external dimensions and at the brim, should have had so small a pubic angle as 47°. In the female the subpubic angle of 89° was considerably greater than in the male with the widest angle.

The greatest transverse diameter of the brim was nearly 3 cm. in front of the sacro-iliac joint, from which point the brim sloped downwards, forwards, and inwards to the pubic symphysis so as to give a cuneiform outline to the brim. In the Manly Cove specimen the transverse diameter of the brim was considerably less than the conjugate, so that the pelvic index was as much as 116; in the other pelves the transverse diameter exceeded the conjugate, though to a very slight extent in two of the adult males. The transverse diameter of the brim in these males ranged from 98 to 123 mm., and the mean was 110·5. The conjugate diameter ranged from 96 to 114 mm., and the mean was 106. The mean pelvic or brim index was 97. In each male pelvis the intertuberal diameter was markedly below the transverse diameter of the brim, but in the only female the intertuberal approximated more to that of the transverse. The mean inferior sagittal diameter in the adult males was 103 mm., which was slightly below the mean conjugate.

The pubic symphysis in the adult males ranged in depth from 36 to 42 mm. The pelvic cavity ranged in depth in the males from 89 to 100 mm., and its mean was 95 mm., which was considerably higher than that of the only female Australian measured. The pubo-innominate index, which expresses the proportion contributed by the os pubis to the breadth of the innominate bone, had a mean in the adult males of 45; in the only female this index was 44. A comparison of the lengths of the ilium and ischium shows the ilium to bear a much larger proportion to the height of the innominate bone than the ischium. The maximum length of the male ilium was 124 mm., the minimum 110 mm. The mean iliac index was 129. The maximum length of the ischium was 95 mm., the minimum 77 mm. In the Riverina pelvis the ischium is two-thirds the length of the ilium, but in the other males the ischium was more than two-thirds, and in the Queensland specimen it was about four-fifths the length of the ilium. In the female, again, the ischium was not quite two-thirds the length of the ilium. The ischio-innominate index, which expresses the proportion contributed by the ischium to the height of the pelvis, had a mean in the adult males of 43; in the only female this index was 40. In three of the adult males the length of the sacrum exceeded the breadth, and the sacral index was consequently less than 100; in two

specimens the length and breadth were equal; in the sixth the breadth appreciably exceeded the length. The mean sacral index was 98. In the only female the sacral index was 101.

Pacific Islanders.—Table II. Plate I.

These specimens consisted of three entire pelves and of two others, each with only the right innominate bone, collected by the Challenger at Oahu in the Sandwich Islands. The crania of A., B., and L. are amongst the dolichocephali in Table XI. of the First Part of this Report; I. is amongst the brachycephali in Table X., and M. amongst the mesaticephali in Table XII. I have also examined the sacrum of a Tonga Islander collected by the Challenger, and the pelves of two New Zealanders from skeletons in the Anatomical Museum of the University of Edinburgh.

The pelves from Oahu were all from adult women, and in them the delicacy and

Table II.—Pacific Islanders.

		Oahu, Sandwich Islands.					Tongan.	New Zealand.	
	Collection,	A. Chal.	B. Chal.	L. Chal.	I. Chal.	M. Chal.	Chal.	Otago. E.U. A.M.	Auckland. E.U. A.M.
	Sex,	F.	F.	F.	F.	F.		M.	M.
A. External dimensions.	1. Breadth of pelvis,	229	275	...	252	...	...	238	255*ep*
	2. Height of pelvis,	174	195	189	176	176	...	188	221
	3. *Breadth-Height Index*,	*76*	*71*	...	*70*	...	..	*79*	*87*
	4. Between ant. sup. iliac spines,	207	...	...	213	...	...	206	...
	5. Between post. sup. iliac spines,	78	91	...	91*ep*	...	...	50	69
	6. Between ischial tubers,	152	167	...	163	...	...	129	155
	7. Between ischial spines,	...	...	...	...	...	...	77	...
	8. Greatest diameter of cotyloid,	43*et*	50*et*	52*et*	47*et*	43*et*	...	52*et*	58*et*
	9. Vertical diameter of obturator foramen,	41	50	46	47	48	...	55	58
	10. Transverse diameter of obturator foramen,	28	35	31	36	39	...	36	40
	11. *Obturator Index*,	*68*	*70*	*67*	*77*	*81*	...	*65*	*69*
	12. Subpubic angle,	93°	84°	...	102°	...	...	65°	...
B. Dimensions of cavity of true pelvis.	13. Transverse diameter of brim,	121	134	...	129	...	...	109	122
	14. Conjugate diameter of brim,	100	121	...	99	...	...	104	118*ep*
	15. *Pelvic or Brim Index*,	*83*	*90*	...	*77*	...	...	*95*	*97*
	16. Oblique diameter of brim { Right,	117	140	...	125	...	...	107	125
	16. Oblique diameter of brim { Left,	121	134	...	126	...	...	111	122
	17. Inferior sagittal diameter,	103	121	...	104	109	...	99	104
	19. Intertuberal diameter,	130	134	...	134	...	...	86	121
	20. Depth of pubic symphysis,	34	37	36	36	37	...	41	43
	21. Depth of pelvic cavity,	86	95	96	84	88	...	92	106
C. Dimensions of individual bones.	22. Height-length of ilium,	101	118	105	101	101	...	106	135*ep*
	23. Breadth of ilium,	138	164	165	149	142	...	149	...
	24. *Iliac Index*,	*137*	*139*	*157*	*147·5*	*141*	...	*140·5*	...
	25. Breadth of innominate bone,	145	177	176	152	153	...	149	...
	26. Length of os pubis,	68	77	76	72	70	...	67	...
	27. *Pubo-innominate Index*,	*47*	*43·5*	*43*	*47*	*46*	...	*43*	...
	28. Length of ischium,	75	82	90	78	81	...	83	91
	29. *Innominate Index*,	*83*	*91*	*93*	*86*	*87*	...	79	...
	30. *Ischio-innominate Index*,	*43*	*42*	*48*	*44*	*46*	...	*44*	...
	31. Length of sacrum,	98	100	94	105	101	101	101	120
	32. Breadth of sacrum,	108	122	114	114	105	116	97	115
	33. *Sacral Index*,	*110*	*122*	*121*	*108·5*	*104*	*115*	*96*	*96*

smoothness of the bones were well marked. They had evidently been buried in sand; with one exception they were light and friable and semitranslucent in the iliac fossa. The wings of the ilia were expanded, especially in L. The maximum breadth was 275 mm., the minimum 229, and the mean of three pelves was 252 mm. The maximum height was 195 mm., the minimum 174, and the mean of five pelves was 182 mm. The mean breadth-height index was 72. The breadth between the antero-superior iliac spines was more than twice as great as that between the postero-superior spines. The greatest diameter of the cotyloid ranged from 43 to 52 mm. The mean vertical diameter of the obturator foramen was 46 mm., and the mean transverse was 34 mm., whilst the mean obturator index was 73. The subpubic angle ranged from 84° to 102°.

The pelvic brim did not possess a cuneiform but an oval shape, the long axis of the oval being transverse. The mean transverse diameter was 128 mm., the mean conjugate 107 mm. Owing to the transverse diameter in each pelvis being so much in excess of the conjugate, the mean pelvic or brim index was 83. The intertuberal diameter was either equal to or in excess of the transverse diameter of the brim. The mean inferior sagittal diameter was 109 mm., which was slightly above the mean conjugate.

The pubic symphysis ranged in depth from 34 to 37 mm.; the pelvic cavity from 84 to 96 mm., the mean depth being 90 mm. The pubo-innominate index had a mean of 45. The maximum length of the ilium was 118 mm., the minimum 101, and the mean iliac index was 144. The maximum length of the ischium was 90 mm., the minimum 75 mm. In all these pelves the ilium was longer than the ischium; in A. the ischium was three-fourths the length of the ilium, in I. and M. something more than three-fourths, in B. something less than three-fourths, and in L. the ischium was six-sevenths the length of the ilium. The mean ischio-innominate index was 44·6. In each pelvis the breadth of the sacrum exceeded the length and contributed materially to the great transverse diameter of the pelvic brim which one finds in these female pelves. The sacral index was therefore high, and had a mean of 113. In the sacrum of the Tonga Islander the sacral breadth was considerably in excess of the length, and the sacral index was 115.

The two New Zealand pelves were males, the one from Otago, the other was found in a cave at Te Aroha,[1] Auckland. The wings of the ilia were moderately expanded; the Otago pelvis was thin in the iliac fossæ. The Auckland pelvis exceeded that from Otago in its dimensions, but the latter had not reached its full magnitude, as the epiphyses were only partially ankylosed. The ilia and ossa pubis had unfortunately been broken in the Auckland pelvis. The measurements, so far as they could be made, are given in

[1] Mr. A. C. Purchas, M.B., by whom the imperfect skeleton of this Maori was presented to the Museum, told me that the bones were found by his brother in 1883, in a recess in the cave, which was the usual mode of burial in former times amongst the natives.

Table II., but the specimens are too few on which to frame a race average. In the Auckland pelvis the height of the pelvis was great in relation to the breadth, and the breadth-height index was as high as 87. In the Otago pelvis the distance between the postero-superior spines was one-fourth of that between the antero-superior spines. The mean obturator index was 67. In both, the transverse diameter of the pelvic brim only slightly exceeded the conjugate, and the mean pelvic index was 96; the outline of the brim approached the cuneiform. The intertuberal diameter was, in the Otago pelvis, much below the transverse diameter of the brim, but in the Auckland specimen they were about equal. The mean inferior sagittal diameter was 101 mm., which was distinctly below the mean conjugate diameter, 111 mm. The mean depth of the pelvic cavity was 96 mm. In the Auckland pelvis the ischium was two-thirds the length of the ilium, in that from Otago the ischium was more nearly three-fourths the length of the ilium. In each specimen the length of the sacrum exceeded the breadth, and the index in both specimens was 96.

African Negros.—Table III. Plate II.

I have examined and measured the pelvis in four adult male skeletons marked Negro, three of which are in the Anatomical Museum of the University, and one in the Barclay collection in the Museum of the Royal College of Surgeons, Edinburgh. Also the pelves of two Negresses and that of a male skeleton marked Creole in the University Museum.

The bones of the Negros, both male and female, were substantial in texture. The iliac fossæ looked forwards, upwards, and inwards, and the breadth of the alæ was small. The maximum breadth of the male pelvis was 260 mm., the minimum 230 mm., the mean 244 mm.; the mean breadth of the females was 241 mm. The maximum height of the males was 210 mm., the minimum 177 mm., the mean 196 mm.; the mean height of the females was 176·5 mm. The mean breadth-height index of the males was 80, that of the females was 73. In the males the breadth between the antero-superior iliac spines was between three and four times greater than that between the postero-superior spines, whilst in the females it was not three times as great. The greatest diameter of the cotyloid in the two sexes ranged from 47 to 56. The mean vertical diameter of the obturator foramen in the males was 52·5 mm., and in the females 44·5. The mean transverse diameter of this foramen in the males was 32, and in the females 30·5 mm. The mean obturator index in the males was 60, and in the females 68·5. The subpubic angle ranged in the males from 52° to 68°, and in the females from 71° to 76°.

In the male the pelvic brim approximated somewhat in outline to the cuneiform, but the female was more rounded; in both sexes the transverse diameter of the brim always exceeded the conjugate. In the males the transverse diameter ranged from 97 to 119 mm., and the mean was 110; in the females it was from 115 to 126 mm., and the mean

was 120·5. The conjugate in the males ranged from 85 to 109 mm., and the mean was 95; in the females from 102 to 109 mm., and the mean was 105·5. The mean pelvic or brim index was 87 in the males, 88 in the females. In both the males and females the intertuberal diameter was considerably less than the transverse diameter of the brim of the pelvis. The mean inferior sagittal diameter in the males was 107, in the females 133; in each sex it was considerably above the mean conjugate of that sex.

The pubic symphysis varied in depth in the males from 36 to 42 mm., and in the females it was 33 and 34 mm. respectively; the depth of the pelvic cavity was less in the females (mean 89 mm.) than in the shallowest (92 mm.) of the males. The mean pubo-innominate index in the males was 41, and in the females it was also 41. The maximum length of the ilium was 125 mm., the minimum 96; the mean iliac index was 130 in the males and 146 in the females. The maximum length of the ischium (a male) was 88 mm., the minimum (a female) 76. The ischium was usually about two-thirds or three-fourths the length of the ilium, but in one male it was as much as seven-eighths

Table III.—Negro.

		Collection.	E.U.A.M.	E.U.A.M.	E.U.A.M.	Barclay Mus.	E.U.A.M.	E.U.A.M.	Creole. E.U.A.M.
		Sex,	M.	M.	M.	M.	F.	F.	M.
A. External dimensions.	1.	Breadth of pelvis,	241	205	246	230	237	243	276
	2.	Height of pelvis,	194	210	208	177	170	183	211
	3.	*Breadth-Height Index*,	*80*	*81*	*82·5*	77	*72*	*74*	*76*
	4.	Between ant. sup. iliac spines,	211	221	223	214	219	224	258
	5.	Between post. sup. iliac spines,	58	64	66	56	76	80	58
	6.	Between ischial tubera,	120	148	140	124	137	152	141
	7.	Between ischial spines,	67	91	87	71	91	112	73
	8.	Greatest diameter of cotyloid,	54e	56e	52e	47e	48e	53et	58e
	9.	Vertical diameter of obturator foramen,	57	55	49	49	41	48	50
	10.	Transverse diameter of obturator foramen,	35	37	30	25	27	34	34
	11.	*Obturator Index*,	*61*	*67*	*61*	*51*	*66*	*71*	*68*
	12.	Subpubic angle,	52°	68°	59°	54°	76°	71°	61°
B. Dimensions of cavity of true pelvis.	13.	Transverse diameter of brim,	115	119	108	97	115	126	127
	14.	Conjugate diameter of brim,	109	94	93	85	109	102	115
	15.	*Pelvic* or *Brim Index*,	*95*	*79*	*86*	*88*	*95*	*81*	*90·5*
	16.	Oblique diameter of brim { Right,	120	119	107	95	121	123	132
		{ Left,	119	118	114	95	119	130	129
	17.	Inferior sagittal diameter,	105	124	102	97	117	159	110
	18.	Coccygeo-pubic diameter,	...	119	...	...	...	...	89
	19.	Intertuberal diameter,	83	93	85	77	98	101	95
	20.	Depth of pubic symphysis,	38	42	37	36	34	33	42
	21.	Depth of pelvic cavity,	92	98	99	97	87	93	94
C. Dimensions of individual bones.	22.	Height-length of ilium,	115	125	118	96	96	101	131
	23.	Breadth of ilium,	152	147	151	135	138	149	155
	24.	*Iliac Index*,	*132*	*118*	*128*	*141*	*144*	*147·5*	*118*
	25.	Breadth of innominate bone,	167	163	158	...	172	176	...
	26.	Length of os pubis,	67	70	65	64	68	75	77
	27.	*Pubo-innominate Index*,	*40*	*43*	*41*	...	*39·5*	*43*	...
	28.	Length of ischium,	81	88	86	84	76	83	94
	29.	*Innominate Index*,	*86*	*78*	*78*	...	*101*	*96*	...
	30.	*Ischio-innominate Index*,	*42*	*42*	*44*	*47*	*45*	*45*	*44·5*
	31.	Length of sacrum,	96	97	96	90	93	111	110
	32.	Breadth of sacrum,	104	116	111	101	101	99	120
	33.	*Sacral Index*,	*108*	*119*	*116*	*112*	*109*	*89*	*109*
	34.	Length of coccyx,	...	22	...	...	...	...	33
	35.	Breadth of coccyx,	...	31	...	...	...	...	46

of the iliac length. The mean ischio-innominate index in the males was 44, in the females 45. In each pelvis the breadth of the sacrum exceeded the length, with the exception of one of the females. The mean sacral index of the four males was 114, of the two females 99.

Andaman Islanders.—Table IV. Plate II.

The specimens under examination consisted of one adult male, two adult females, a young male and a young female, all in the University Anatomical Museum, and presented by Drs. Joseph Dougal, J. S. Forrester, and D. D. Cunningham, and an adult female in the Museum of the Royal College of Surgeons, Edinburgh, presented by Dr. E. S. Brander.

The following description is drawn up from the adult pelves, the general dimensions of which were small, and in relation to the short stature and generally small proportions of the race, but the pelvic bones were substantial, not translucent in the iliac fossæ, and the alæ were expanded. In the three females the breadth of the pelvis varied from 196 to 235 mm., with a mean of 214 mm.; in height they ranged from 157 to 166, with a mean of 162 mm. The mean breadth-height index was 76. In the adult male the proportion of height to breadth was somewhat smaller, and the mean index was 75. In both the females and the adult male the breadth between the antero-superior iliac spines was between two and three times greater than between the postero-superior iliac spines. The greatest diameter of the cotyloid in the two sexes ranged from 42 to 47 mm. The mean vertical diameter of the obturator foramen in the females was 42 mm.; the mean transverse diameter was 30 mm.; the mean obturator index of the females was 72, the index of the only adult male was 70. The subpubic angle ranged in the female from 81° to 88°, in the male it was only 68°.

In both the adult male and females the pelvic brim inclined to the cuneiform shape, though in the females, owing to the greater transverse diameter of the brim, the form was more rounded than in the male. In the females the transverse diameter ranged from 106 to 117 mm., with a mean of 111; in the male the transverse diameter was 102 mm. In the females the conjugate diameter ranged from 92 to 100 mm., and the mean was 97; in the male this diameter was 99 mm. The mean pelvic or brim index in the adult females was 87, the same index in the male was 97, and in both the young male and young female the transverse and conjugate diameters were so nearly equal that their mean pelvic index was 100. In the male the intertuberal diameter was much less than the transverse diameter of the brim, but in the females and young specimens it closely approached it in the same pelvis. The mean inferior sagittal diameter in the females was 109 mm., which was considerably above the mean conjugate, but in the male the inferior sagittal diameter was less than the conjugate.

The pubic symphysis ranged in depth from 27 to 39 mm. In the adult females the

pelvic cavity had a mean depth of 79 mm., in the male it was also 79 mm. The mean pubo-innominate index of the adult females was 45·5, that of the male was 45. The maximum length of the ilium in the adult females was 105 mm., the minimum 93, the mean was 100 mm.; in the male the length was 99 mm. The maximum length of the ischium in the adult females was 71 mm., the minimum 68, the mean was 70 mm. In the adult females the ischium ranged from about two-thirds to three-fourths the length of the ilium; in the male the ischium was nearly two-thirds the length of the ilium. The mean ischio-innominate index in the adult females was 43, and this index was also 43 in the single adult male. In each adult pelvis the breadth of the sacrum exceeded the length; the mean sacral index in the adult females was 111, and the same index in the adult male was 114. In the young female the index was only 96·5.

TABLE IV.—ANDAMAN ISLANDERS.

	Collection,	E.U.A.M.	E.U.A.M.	E.U.A.M.	R.C.S. Ed.	E.U.A.M.	E.U.A.M.
	Sex,	M.	F.	F.	F.	Y. M.	Y. F.
A. External dimensions.	1. Breadth of pelvis,	211	210	235	196	194	...
	2. Height of pelvis,	159	166	164	157	152	...
	3. *Breadth-Height Index*,	*75*	*79*	*70*	*80*	*78*	...
	4. Between ant. sup. iliac spines,	189	...	218	180	176	...
	5. Between post. sup. iliac spines,	68	76	81	67	70	59
	6. Between ischial tubera,	113	129	139	135	120	117
	7. Between ischial spines,	66	...	94	...	69	75
	8. Greatest diameter of cotyloid,	44*c*	42*c*	46*l*	47*c*	45*c*	44*c*
	9. Vertical diameter of obturator foramen,	43	37	42	46	40	42
	10. Transverse diameter of obturator foramen,	30	29	30	31	26	25
	11. *Obturator Index*,	*70*	*78*	*71*	*67*	*65*	*59·5*
	12. Subpubic angle,	68°	84°	88°	81°	78°	81°
B. Dimensions of cavity of true pelvis.	13. Transverse diameter of brim,	102	106	117	109	90	94
	14. Conjugate diameter of brim,	99	99	100	92	92	92
	15. *Pelvic or Brim Index*,	*97*	*93*	*85*	*84*	*102*	*98*
	16. Oblique diameter of brim { Right,	108	109	114	111	95	97
	16. Oblique diameter of brim { Left,	108	111	120	111	93	97
	17. Inferior sagittal diameter,	90	103	111	112	84	82
	19. Intertuberal diameter,	77	104	105	104	85	89
	20. Depth of pubic symphysis,	35	27	39	34	33	31
	21. Depth of pelvic cavity,	79	76	79	82	74	75
C. Dimensions of individual bones.	22. Height-length of ilium,	99	101	105	93	90	...
	23. Breadth of ilium,	124	123	130	125	113	...
	24. *Iliac Index*,	*125*	*122*	*124*	*134*	*125*	...
	25. Breadth of innominate bone,	143	147	154	...	134	...
	26. Length of os pubis,	64	70	67	62	59	58
	27. *Pubo-innominate Index*,	*45*	*48*	*43*	...	*44*	...
	28. Length of ischium,	69	71	68	71	68	66
	29. *Innominate Index*,	*90*	*89*	*93*	...	*88*	...
	30. *Ischio-innominate Index*,	*43*	*43*	*41*	*45*	*45*	...
	31. Length of sacrum,	84	87	102	87	87	87
	32. Breadth of sacrum,	96	100	114	93	92	84
	33. *Sacral Index*,	*114*	*115*	*112*	*107*	*106*	*96·5*

Asiatics.—Table V. Plate II.

In Table V. I have given the measurements of the pelves of five Asiatics, all in the Anatomical Museum of the University. With the exception of two Hindoos, the rest are single specimens of their respective races—Sikh, Chinese, and Malay.[1] They can only be taken therefore as individual specimens, and in themselves do not give us the mean of their respective races.

Table V.—Asiatics.

		Hindoo.		Sikh.	Chinese.	Malay.
	Collection,	E.U.A.M.	E.U.A.M.	E.U.A.M.	E.U.A.M.	E.U.A.M.
	Sex,	M.	F.	M.	M.	M.
A. External dimensions.	1. Breadth of pelvis,	241	245	278	265	235
	2. Height of pelvis,	187	172	220	193	200
	3. *Breadth-Height Index*,	*78*	*70*	*79*	*73*	*85*
	4. Between ant. sup. iliac spines,	211	239	266	251	193
	5. Between post. sup. iliac spines,	57	75	76	75	69
	6. Between ischial tubera,	120	140	148	147	151
	7. Between ischial spines,	70	...	82	89	85
	8. Greatest diameter of cotyloid,	57*c*	45*ct*	62*ct*	58*c*	54*c*
	9. Vertical diameter of obturator foramen,	47	45	56	45	55
	10. Transverse diameter of obturator foramen,	31	32	38	25	34
	11. *Obturator Index*,	*66*	*71*	*68*	*55·5*	*62*
	12. Subpubic angle,	57°	78°	62°	76°	76°
B. Dimensions of cavity of true pelvis.	13. Transverse diameter of brim,	108	120	125	114	110
	14. Conjugate diameter of brim,	96	112	113	97	116
	15. *Pelvic* or *Brim Index*,	*89*	*93*	*90*	*85*	*105*
	16. Oblique diameter of brim { Right,	113	125	130	113	116
	16. Oblique diameter of brim { Left,	113	122	127	117	115
	17. Inferior sagittal diameter,	108	106	114	100	106
	18. Coccygeo-pubic diameter,	91	85	...	...	...
	19. Intertuberal diameter,	78	109	94	105	109
	20. Depth of pubic symphysis,	39	34	51	35	42
	21. Depth of pelvic cavity,	91	84	102	94	100
C. Dimensions of individual bones.	22. Height-length of ilium,	108	100	130	109	113
	23. Breadth of ilium,	143	130	163	152	150
	24. *Iliac Index*,	*132*	*130*	*125*	*139*	*133*
	25. Breadth of innominate bone,	154	156	181	160	171
	26. Length of os pubis,	64	68	79	62	69
	27 *Pubo-innominate Index*,	*42*	*44*	*44*	*39*	*40*
	28. Length of ischium,	83	75	95	84	90
	29. *Innominate Index*,	*82*	*91*	*80*	*83*	*85·6*
	30. *Ischio-innominate Index*,	*44*	*44*	*43*	*43·6*	*45*
	31. Length of sacrum,	99	81	97	108	112
	32. Breadth of sacrum,	108	103	121	106	106
	33. *Sacral Index*,	*109*	*127*	*124·6*	*98*	*95*
	34. Length of coccyx,	27	30	...	...	...
	35. Breadth of coccyx,	28	26	...	...	...

[1] The Hindoo pelves and skeletons were presented by Sir Joseph Fayrer; the Sikh and Malay, by Dr. D. D. Cunningham.

The Hindoo pelves were a male and a female. In them, as in the male Sikh, the alæ of the ilium were expanded. In the Sikh and female Hindoo the iliac fossæ were semi-translucent, but this was not the case in the male Hindoo. The Sikh dominated largely in its dimensions over the Hindoos, indeed it is one of the largest pelves that I have measured in the course of this inquiry. But notwithstanding this difference in absolute size, there was in many particulars a great similarity in the relative proportions of the Sikh and the male Hindoo. The breadth-height index of the male Hindoo, 78, closely approached that of the Sikh, 79. The obturator indices in these males also closely approximated, in the Hindoo being 66, in the Sikh 68, whilst the female Hindoo again had a higher index, 71. Although in both the Hindoo and the Sikh the transverse diameter of the pelvic brim was greater than the conjugate, yet in these males the inlet narrowed towards the symphysis so that the outline of the brim approximated to the cuneiform. In the female Hindoo this narrowing was not so rapid, and the outline of the brim was more rounded. The pelvic index in the male Hindoo was 89, in the Sikh 90, in the female Hindoo 93. In both these males the intertuberal diameter was about 30 mm. below the transverse diameter of the brim. The inferior sagittal diameter in the male Hindoo and in the Sikh somewhat exceeded the conjugate; in the female Hindoo it was somewhat below the conjugate. The pelvic cavity both in the male Hindoo and in the Sikh was deeper than in the female Hindoo. They differed in the relative value of the iliac index, for in the Hindoo it was 132, in the Sikh 125. The pubo-innominate index in the male Hindoo was 42, in the Sikh 44; the ischio-innominate index, again, in the male Hindoo was 44, in the Sikh 43. They differed also in the sacral index, which in the Sikh was as high as 124·5, and in the male Hindoo only 109, whilst in the female Hindoo it was 127; the breadth of the sacrum, 121 mm., in the Sikh, was indeed quite remarkable for a male pelvis, but as the subpubic angle was only 62°, this great sacral breadth, though associated with a correspondingly wide brim, had not occasioned an opening out of the subpubic angle.

The Chinese pelvis in its external dimensions was in most of its measurements larger than the Malay. In both the iliac fossæ were somewhat thinned, but the alæ were expanded, flattened, and thrown outwards in the Chinese, and more nearly vertical and looking inwards in the Malay. In the Chinese the anterior border of the ilium sloped upwards and outwards, and the anterior inferior spines were 173 mm. from each other, being 78 mm. less than the diameter between the anterior superior spines; in the Malay the anterior border of the ilium was nearly vertical, and the anterior inferior spines were 183 mm. asunder, being only 10 mm. below the distance between the anterior superior spines. The proportions of breadth and height were very different, the index in the Chinese being 73, in the Malay 85. The dimensions of the obturator foramen were larger in the Malay pelvis, in which the obturator index was 62, whilst in the Chinese it was 55·5. They differed materially from each other in the shape and diameters of the pelvic brim,

for the Malay was ovoid in the conjugate diameter and had a pelvic index of 105; the Chinese was ovoid from side to side, and had a pelvic index of 85. Whilst the Chinese was 4 mm. greater in the transverse diameter of its brim, the conjugate diameter of the Malay was 19 mm. in excess of the Chinese, but the subpubic angle was in each 76°. The intertuberal and the transverse diameters of the brim were almost equal in the Malay, but in the Chinese the transverse diameter was 9 mm. in excess of the intertuberal. The iliac index was in the Chinese 139, in the Malay 133. The pubo-innominate and ischio-innominate indices were in the Chinese respectively 39 and 43·5, in the Malay 40 and 45. In both pelves the sacrum was distinctly longer than broad, but in the Chinese, whilst the sacral index was 98, in the Malay it was only 95.

Guanche and Bush.—Table VI. Plate III.

The specimens of Guanche pelves were an entire male, the sacrum and right innominate of another male, and the left innominate of a third pelvis. They were collected by Dr. W. H. Miller of Las Palmas, in caves in the Grand Canary Island, and were presented to the Anatomical Museum, along with four Guanche skulls, through Professor Alexander Simpson.

The bones in these specimens were substantial in texture and were not translucent in the iliac fossæ. The only entire specimen was well formed and symmetrical, and with well-expanded ilia, not semitranslucent in the iliac fossæ. Its breadth-height index was 77. The subpubic angle was 62°, and the pelvic or brim index 85. Although the transverse diameter of the brim was considerably in excess of the conjugate, yet the outline of the pelvic inlet could not be described as oval but rather as something intermediate between round and oval. The intertuberal diameter was much below the transverse diameter of the brim. In all three the greatest diameter of the cotyloid was vertical. The obturator index ranged from 68 to 78, with a mean of 74. The inferior sagittal diameter slightly exceeded the conjugate. The pelvic cavity varied in depth from 86 to 101 mm. The mean pubo-innominate index of the two males was 41, and the mean ischio-innominate was 43. The length of the ischium in these specimens was about three-fourths that of the ilium. The maximum length of the ilium was 129 mm., the maximum length of the ischium in the same pelvis was 93 mm. There was but little variation in the innominate index, the range being only 3. In both the specimens with a sacrum, the breadth of that bone exceeded the length by several millimètres, and the mean sacral index was 108·5.

The Bush pelvis belonged to the male skeleton from Umzimkulu, the measurements of the skull of which are given in Table I. in the First Part of this Report. The dimensions of this pelvis were small in accordance with the small stature and proportions of the race; the bones also were light, but substantial and not translucent in the iliac

fossæ; these fossæ looked almost directly inwards, the wings and the anterior border of each ilium approached the vertical in direction, and the crest was short. The distance between the anterior inferior spines was 161 mm., only 13 mm. less than that between the anterior superior spines. The breadth of the pelvis was restricted in relation to the height, so that the breadth-height index was as much as 91. The obturator index was 75·5, which expresses a relatively wide obturator foramen. The transverse diameter of the pelvic brim was markedly below the conjugate, and the shape of the inlet was oval in the antero-posterior direction; the pelvic index was 109. The intertuberal diameter corre-

TABLE VI.—GUANCHE AND BUSH.

		Guanche.			Bush.
	Collection,	E.U.A.M.	E.U.A.M.	E.U.A.M.	E.U.A.M.
	Sex,	M.	M.		M.
A. External dimensions.	1. Breadth of pelvis,	265	...	...	202
	2. Height of pelvis,	205	213	207	183
	3. *Breadth-Height Index*,	*77*	...	...	*91*
	4. Between ant. sup. iliac spines,	...	...	...	174
	5. Between post. sup. iliac spines,	75	...	...	57
	6. Between ischial tubera,	143	...	...	122
	7. Between ischial spines,	...	...	...	74
	8. Greatest diameter of cotyloid,	55*c*	55*c*	55*c*	49*c*
	9. Vertical diameter of obturator foramen,	50	56	46	45
	10. Transverse diameter of obturator foramen,	38	38	36	34
	11. *Obturator Index*,	*76*	*68*	*78*	*75·5*
	12. Subpubic angle,	62°	...	...	72°
B. Dimensions of cavity of true pelvis.	13. Transverse diameter of brim,	122	...	...	93
	14. Conjugate diameter of brim,	104	104	...	101
	15. *Pelvic* or *Brim Index*,	*85*	...	...	*109*
	16. Oblique diameter of brim { Right,	118	...	...	100
	{ Left,	120	...	...	100
	17. Inferior sagittal diameter,	106	109	...	92
	18. Coccygeo-pubic diameter,	...	...	...	79
	19. Intertuberal diameter,	96	...	...	93
	20. Depth of pubic symphysis,	38	49	43	39
	21. Depth of pelvic cavity,	92	101	86	88
C. Dimensions of individual bones.	22. Height-length of ilium,	117	129	118	108
	23. Breadth of ilium,	160	157	160	131
	24. *Iliac Index*,	*137*	*122*	*135*	*121*
	25. Breadth of innominate bone,	169	182	175	150
	26. Length of os pubis,	70	74	83	63
	27. *Pubo-innominate Index*,	*41*	*41*	*47*	*42*
	28. Length of ischium,	87	93	84	81
	29. *Innominate Index*,	*82*	*85*	*84·5*	*82*
	30. *Ischio-innominate Index*,	*42*	*44*	*40·5*	*44*
	31. Length of sacrum,	104	116	...	98
	32. Breadth of sacrum,	118	121	...	96
	33. *Sacral Index*,	*113*	*104*	...	*98*
	34. Length of coccyx,	...	...	...	28
	35. Breadth of coccyx,	...	...	...	29

sponded with the transverse diameter of the brim. The inferior sagittal diameter was below the conjugate. The subpubic angle was 72°. The ischium was something more than four-fifths the length of the ilium; the iliac index was only 121. The innominate index was 82. The pubo-innominate index was 42, and the ischio-innominate index was 44. The sacrum was a little longer than broad, and the sacral index was 98.

Esquimaux and Laplanders.—Table VII. Plate III.

The Esquimaux pelves belonged to two skeletons, a male and a female, which the University Museum acquired from the collection formed by Dr. Alexander Monro *tertius*.

Table VII.—Esquimaux and Laplanders.

		Esquimaux.		Laplanders.	
	Collection,	E.U.A.M.	E.U.A.M.	E.U.A.M.	E.U.A.M.
	Sex,	M.	F.	M.	F.
A. External dimensions.	1. Breadth of pelvis,	274	253	236	228
	2. Height of pelvis,	211	196	190	171
	3. *Breadth-Height Index*,	*77*	*77*	*80·5*	*75*
	4. Between ant. sup. iliac spines,	226	227	210	196
	5. Between post. sup. iliac spines,	78	80	54	67
	6. Between ischial tubers,	143	160	128	160
	7. Between ischial spines,	...	107	74	117
	8. Greatest diameter of cotyloid,	57*c*	55*c*	51*c*	48*c*
	9. Vertical diameter of obturator foramen,	57	51	50	37
	10. Transverse diameter of obturator foramen,	43	36	33	27
	11. *Obturator Index*,	*75*	*70·5*	*66*	*73*
	12. Subpubic angle,	69°	74°	70°	104°
B. Dimensions of cavity of true pelvis.	13. Transverse diameter of brim,	126	132	105	120
	14. Conjugate diameter of brim,	111	111	98	87
	15. *Pelvic* or *Brim Index*,	*88*	*84*	*93*	*72·5*
	16. Oblique diameter of brim { Right,	126	131	107	114
	{ Left,	125	129	109	122
	17. Inferior sagittal diameter,	117	134	96	113
	19. Intertuberal diameter,	88	118	95	123
	20. Depth of pubic symphysis,	42	36	40	33
	21. Depth of pelvic cavity,	102	94	92	80
C. Dimensions of individual bones.	22. Height-length of ilium,	122	115	111	93
	23. Breadth of ilium,	163	151	142	143
	24. *Iliac Index*,	*134*	*131*	*128*	*154*
	25. Breadth of innominate bone,	188	171	167	161
	26. Length of os pubis,	80	75	66	70
	27. *Pubo-innominate Index*,	*42·5*	*44*	*39·5*	*43*
	28. Length of ischium,	92	83	81	77
	29. *Innominate Index*,	*89*	*87*	*88*	*94*
	30. *Ischio-innominate Index*,	*44*	*42*	*43*	*45*
	31. Length of sacrum,	80	109	86	93
	32. Breadth of sacrum,	111	116	91	104
	33. *Sacral Index*,	*139*	*106*	*106*	*112*

Both pelves were well developed, and, in the external dimensions of breadth and height, were amongst the largest measured in their respective sexes. The alæ of the ilium were moderately expanded, the male only was semitranslucent in the iliac fossæ. The breadth-height index was 77 in each pelvis. The distance between the antero-superior spines was not quite three times more than that between the postero-superior spines. The obturator index in the male was 75, in the female 70·5. The subpubic angle in the male was 69°, in the female 74°. In both, the conjugate diameter of the brim was less than the transverse. In the female the pelvic inlet was oval from side to side, and the index was 84; in the male the transverse elongation was not marked, and the pelvic or brim index was 88. In both, the intertuberal diameter was considerably below the transverse diameter of the brim, though the difference was not nearly so marked in the female as in the male. The inferior sagittal diameter in both exceeded the conjugate, and markedly so in the female. The pelvic cavity was 8 mm. deeper in the male than in the female. The pubo-innominate index was less in the female than in the male, but the ischio-innominate index was greater. In each, the ischium was about three-fourths the length of the ilium, and there was but little difference in their iliac index. The innominate index showed only a slight variation in the two sexes. In both, the breadth of the sacrum exceeded the length, and this was especially the case in the male pelvis, in which the sacrum with its five vertebræ was the shortest that has been recorded in these tables, and the sacral index reached 139.

The Laplanders, a male and a female skeleton, were purchased from a dealer, Mr. Nordvi. The texture of the bones was firm, the alæ of the ilia were moderately expanded, and they were not translucent in the iliac fossæ. In their general dimensions these pelves were larger than either the Bush or Andamanese specimens, but not so large as the Esquimaux. The height of the pelvis was greater in proportion to the breadth in the male than in the female, and the breadth-height indices were respectively 80·5 and 75. The distance between the postero-superior spines was, both absolutely and relatively to that between the antero-superior spines, much greater in the female than in the male. In the male the obturator index was 66, in the female 73. The subpubic angle was 70° in the male and 104° in the female. In both, the transverse diameter of the brim exceeded the conjugate, but this was especially so in the female pelvis, in which the pelvic index was only 72·5, whilst in the male it was 93. These differences very materially affected the form of the pelvic inlet, which was oval transversely in the female, but, in the male, owing to the rapid inward slope of the pubic bones, approximated to the cuneiform. In the male the intertuberal diameter was 10 mm. less than the transverse diameter of the brim, in the female it was 3 mm. more than the transverse diameter. The inferior sagittal diameter was almost equal to the conjugate in the male, but considerably above it in the female. The pelvic cavity was 8 mm. deeper in the male than in the female. Both the pubo-innominate and ischio-innominate indices in the male were below

the corresponding indices in the female. In the male the ilium was much longer than in the female, but the breadth of this bone was almost equal in the two specimens, so that there was a great difference in their respective iliac indices. The difference between the lengths of the ilium and ischium was much greater in the man than in the woman. The innominate index was distinctly greater in the male than in the female. In both, the breadth of the sacrum exceeded the length, the index in the male being 106, in the female 112.

General Remarks on the Pelves.

The pelves, the measurements of which are recorded in the foregoing tables, are from a number of races living for the most part a savage and primitive life, and in several instances, as the Andaman Islanders, Bush, and Laplanders, are people of diminutive stature. They consist, including both pelves and separate innominate bones, of twenty-four adult males and fourteen adult females.

1. Sexual Characters.

As sex influences in a very important manner the form and proportions of the pelvis, I shall, in the first place, make some observations on their sexual characters.

The female pelvis in its construction and proportions is modified so as to give space for the enlargement of the uterus during gestation, and for the expulsion of the child during parturition; and, in relation to these two functions, its inlet and outlet require to be more open, and its cavity more capacious and shallower than in the male. In accordance with the shorter stature and generally smaller bulk of a woman than of a man, the external dimensions of the entire pelvis are on a smaller scale in the female than in the male. The mean height in the series of adult males now before me was 197, and in the adult females 175; the mean breadth in the males was 248, and in the females 235. It will be seen therefore that the height diminished in a greater ratio than the breadth, and this difference is expressed by the mean breadth-height index, which was only 74 for the adult females, but 80 for the adult males. The pelvic cavity was as a rule shallower in the women than in the men; the mean depth in the females was 85 mm., in the males 95 mm.

The proportions of the obturator foramen also differed in the two sexes, for whilst there was not, as a rule, any very marked difference in its transverse diameter in the two sexes, the vertical diameter, in accordance with the greater depth of the pelvic cavity, was considerably more in the males than in the females. The females therefore had a much higher obturator index than the males; the mean of the series for the females was 73, for the males 67. The greater relative capacity of the female than of the male pelvis, and the relatively larger areas of the inlet and outlet, are also shown in

the tables. In the series of female pelves the mean sacral breadth was 106 mm., and the broadest sacrum measured, that of a woman from Oahu, was 122 mm. In the series of males, notwithstanding the greater general dimensions of the pelvis and the unusually broad sacrum in the Sikh (121 mm.), the Creole (120 mm.), and a Guanche (121 mm.), the mean sacral breadth was not more than 107 mm. The mean sacral index in the males was 106, in the females 110, so that the sacrum was broader in proportion to its length in the women than in the men. The diameter between the postero-superior spines was, in relation to that between the antero-superior spines, greater in the females than in the males. Thus whilst in twenty males the mean diameter between the antero-superior spines was 218 mm. and that between the postero-superior spines only 64 mm., in ten females with a mean antero-superior diameter of only 211 mm., the mean postero-superior was as high as 78 mm. The subpubic angle was much wider in the females than in the males; the range in the males was from 47° in an Australian to 76° in both a Chinese and a Malay, the mean of the series being 64°; the range in the females was from 71° in a Negress to 102° in an Oahuan and 104° in a Laplander, the mean of the series reaching 85°.

The mean transverse diameter of the brim in the males was 109 mm., in the females 120 mm. The mean conjugate diameter of the brim in the males was 104 mm., in the females 103 mm. Whilst the mean antero-posterior diameter of the pelvic inlet was almost equal therefore in the two sexes, the mean transverse diameter was considerably greater in the women than in the men, and consequently the brim more usually assumed in the women an oval outline with the long axis transverse. These differences are expressed in the brim or pelvic index, which had a mean in the whole series of males of 93, in the females of 86. The mean intertuberal diameter, which expresses the transverse diameter of the pelvic outlet, was 113 mm. in the females and only 90 mm. in the males; in the females the intertuberal diameter approximated to the transverse diameter of the brim in the same sex, whilst in the male pelvis the intertuberal diameter fell much below the transverse; the side wall of the pelvic cavity inclined therefore downwards and inwards in the male, whilst it was more nearly in the vertical plane in the female. The mean inferior sagittal diameter, which expresses the antero-posterior diameter of the immovable part of the pelvic outlet, was in the males 104 mm.—precisely the same as the mean conjugate diameter of the brim in the same sex, whilst the mean sacro-pubic diameter in the females was 113 mm., which was considerably in excess of the mean conjugate diameter in that sex; the antero-posterior diameter of the pelvic cavity therefore increases in women very materially from brim to outlet. As the pubo-innominate index was in the males 42·7 and in the females 44, the os pubis contributed a larger proportion to the breadth of the innominate bone in the women than in the men. In the series of adult males the mean ischio-innominate index was 43·5, and in the adult females 43·7, so that the proportion which the ischium contributed to the height of the pelvis was practically alike in the two sexes. The

mean innominate index in the males was 82·2, in the females 90·7, so that the innominate bone in relation to the height of the pelvis was considerably broader in the women than in the men. The mean iliac index in the males was 130, in the females 138, so that in the women the ilium was broader in relation to its length than in the men.

The sexual characters of the female pelvis, as deduced from the examination of this series of pelves belonging to different races, may be summarised as follows:—The height was proportionally less than the breadth, the pelvic cavity was shallower, the difference between the vertical and transverse diameters of the obturator foramen was not so great, the sacrum was relatively broader, the distance between the postero-superior iliac spines was greater, the subpubic angle was much wider, the transverse diameter of the brim was greater, the pelvic inlet was more usually oval transversely, the intertuberal diameter was greater, the side wall of the pelvic cavity was more nearly in the vertical plane, the inferior sagittal diameter was greater, the os pubis formed a larger proportion of the breadth of the innominate bone, and both the innominate bone itself and its iliac portion were relatively broader in the women than in the men. To the above characters, obtained by pelvimetrical methods, should be added the greater delicacy and smoothness of the bones, owing to the muscular ridges and processes being less strongly marked in the women than in the men. The constancy of these characters, with occasional individual exceptions in some one feature or other, in the female pelves necessarily mask in them such differences as may be due to race, so that the male pelvis is more suitable for the study of racial differences than is the female.

2. Race Characters.

We may, in the next place, proceed to the consideration of the race characters of these pelves, though, unfortunately, the number of pelves belonging to some of the races is so small that it is impossible to say whether the special features which they exhibit are racial or only individual characters. Still, the measurements record the several diameters which have been taken, and they may be useful to future observers, who may be more fortunate in obtaining a greater number of specimens, as furnishing them with additional material for comparison.

The points which will more especially require attention are the breadth and height of the entire pelvis, the shape of the pelvic brim, the relations of its transverse and conjugate diameters, and the relative length and breadth of the sacrum. But reference will be also made to some other questions which have arisen in the course of this enquiry.

a. Relations of Breadth and Height.

In the first instance I shall consider the relations of the breadth and height of the entire pelvis, and may premise by stating that when the breadth-height index is high the height of the pelvis is great in relation to the breadth, whilst conversely a low breadth-height index expresses a broad pelvis in relation to the height. I shall begin by referring to some observations on the breadth and height of the pelvis of Europeans. Several anatomists and obstetricians have recorded the mean height and breadth of the entire pelvis in both the men and women of some of the nations of Europe. M. Verneau gives the mean height of sixty-three male pelves, presumably French, as 220 mm., and of thirty-five female pelves as 197 mm. John Wood's height-dimensions of pelves, presumably British, are for fourteen men 221 mm. (8 inches 7 lines), and for eighteen women 190 mm. (7 inches 5 lines). J. G. Garson's measurement of the pelvic height in fourteen European women, without specification of the particular race, is 202 mm., somewhat higher therefore than those of M. Verneau and J. Wood for the same sex. The maximum breadth of the pelvis between the iliac crests is stated by Meckel to be 211 mm. in men and 239 in women, by Burns to be 280 mm. (11 inches) in women, by Verneau to be 279 mm. in men and 266 in women, and by Garson to be 271 in women. From measurements which I have made on pelves in the dissecting room, and therefore presumably Scotch, the mean maximum breadth in six men was 300 mm., and in eleven women 293 mm. Verneau places the breadth-height index in European males at 79, and in females at 74; whilst the same index, calculated from Garson's measurements of European women, is 75. C. Martin states that in the European female pelvis the alæ of the ilium are for the most part translucent, and that the distance between the opposite iliac crests and spines is the largest amongst all the races that have been measured.

Although there is a certain amount of variation in the breadth and height dimensions as recorded by the above observers, yet it will be seen, from an examination of the preceding tables, that the Sikh was the only pelvis which in its height, 220 mm., and in its breadth, 278 mm., equalled the European male standard, and its index 79 corresponded with the index of Europeans obtained by Verneau; the male Esquimaux with a height of 211 mm., a breadth of 274 mm., and an index 77 closely approached it. These deficiencies in breadth and height, as compared with Europeans, are without doubt correlated with the shorter stature of the races comprised in the tables, and these defects in stature will appear more strongly in the chapter on the bones of the shaft of the lower limbs.

When compared with each other, the pelves measured in this Report exhibited differences in the relative proportions of breadth and height, which differences were expressed by variations in the breadth-height index. Amongst the female pelves these differences were not very great, and ranged from an index of 70 in the single Hindoo and

72 in the series of Sandwich Islanders to 77 in the single Esquimaux. Amongst the males the variations were much more strongly marked, and ranged from an index of 73 in the single Chinese and 75 in the single adult Andamanese to 91 in the single Bush pelvis.

This Bush pelvis is distinguished therefore from all the other pelves by its height in proportion to its breadth, and by the vertical direction of the ilium, and we may now enquire how far these relations, so strongly marked in this male pelvis, are a characteristic of the race. Pelves of Bushmen or Bushwomen have now been examined and described by Vrolik, Johannes Müller, Pruner-Bey, C. Martin, Görtz, Gustaf Fritsch, Verneau,[1] and myself. Unfortunately, some of these observers, although recording the maximum breadth between the iliac crests, have not given in numbers the height of the pelvis. Vrolik had, however, remarked on the great height of his female pelvis in relation to its breadth and on the vertical direction of the ilium. Johannes Müller stated that his female specimen resembled in an extraordinary manner the one figured by Vrolik, and he especially referred to the vertical direction of the ilium, so that the antero-superior and inferior iliac spines were almost in the same vertical plane. In his male pelvis, however, the ilia were much more oblique, and from the measurements of this pelvis given by Gustaf Fritsch the breadth-height index was apparently only 79. Görtz's female pelvis, again, was not so high as Vrolik's and Müller's specimens of the same sex, neither was the ilium so vertical. In Fritsch's adult female the breadth-height index was 84, whilst in the male it was only 81. Verneau stated that in his two female Bush pelves the direction of the ilium and of its anterior border was but a little inclined, I presume, therefore, almost vertical; on the other hand, it would appear that the height was not in them disproportional to the breadth, as he placed the breadth-height index at 77. Although therefore there is not an absolute uniformity in these characters in the several Bush pelves which have been examined, still it is clear that there is a strong tendency in this race for the ilium and its anterior border to approach the vertical in direction, so that the diameter between the antero-superior spines only slightly exceeds that between the antero-inferior spines. It is evident also that the pelvic height is large in proportion to the breadth, and although the variation is considerable from an index of 77 to one of 91, in the five pelves the measurements of which in these diameters have been recorded, yet the mean breadth-height index of the five, both males and females, is 82, considerably above the European mean, and the lowest index in the Bush women 77, is above the mean of European women as given both by Verneau and by Garson. There is no information of the proportion which the ischium contributes to the pelvic height except in the specimen which I have measured, in which it will be seen that the ratio is 81, the length of the ischium, to 183 the height of the pelvis.

[1] It is unnecessary for me either here or subsequently to repeat the references to the papers of the writers referred to in the text, as the titles of their respective memoirs are given in the Bibliographical list on pp. 3, 4, 5.

In one of the male Australians the breadth-height index was 82, but the mean index in the six males was 77, a little below the European male standard. Verneau gives the breadth-height index of one man as 79, and the mean of two women as 74. From Garson's measurements of five Australian women the corresponding index is 76·6, which is also the index of my single female specimen. The Australians therefore, both men and women, correspond closely in the proportions of pelvic height and breadth to Europeans.

In the Sandwich Island women the mean breadth-height index was 72. Of these A. and B., with a breadth-height index of 76 and 71 respectively, belonged to skeletons of dolichocephalic people, whilst I., with a corresponding index of 70, belonged to a brachycephalic person. The range of variation, therefore, of this index in these female pelves was not very great. M. Verneau, who has described five male pelves from Tongatabu, Mangareva, Noukahiva, and Hawaii, has pointed out that in them a wide range of variation existed both in this and some other features of the pelvis, so that he recognised two types of pelvis—the one, represented by the specimens from Tongatabu and Mangareva, he regarded as pure Polynesian, whilst the other bore traces of a Papuan element. The Tongan and Mangarevan were distinguished by the high breadth-height index, which in the former was 85, in the latter 93, whilst in the Noukahivan and Hawaian pelves this index was 79 and 77 respectively. The actual height of the pelvis in the Tongan was 220 mm., in the Mangarevan 228 mm., whilst in the Noukahivan and Hawaian it was only 194 and 200 mm. The Tongan and Mangarevan are, I presume, the pelves of a brachycephalic race, but in the relations of pelvic breadth and height they differed most materially from my brachycephalic Sandwich Islander; still it must be remembered that my pelvis was that of a woman, in which, therefore, for sexual reasons, the breadth dominates over the height much more than in the male. In the two male New Zealanders the breadth-height index of the pelvis was 79 and 87 respectively. I do not possess the cranium belonging to the skeleton from Te Aroha, and I have been unable to identify the skull which belonged to the Otago pelvis.[1]

The Negro pelves in their breadth-height index presented in the males a mean of 80 and in the females one of 73, both of which approximate to the European average in the two sexes. M. Verneau gives the relations of breadth to height in a Negress from Mozambique as 74, exactly the same as in the European female, whilst in other Negresses the same index varied from 73 to 79. In his male pelves, on the other hand, the corresponding index was considerably higher, for in a Negro from Mozambique it reached 85, and in a Nubian it was 84.

In my only adult male Andamanese the breadth-height index was 75, and the mean

[1] Although in the pelvis of the Otago skeleton the epiphyses of the iliac crests and ischial tubera were not in their entire extent fully ankylosed to their respective bones, yet in all probability the pelvic cavity with its inlet and outlet had attained its normal form and proportions.

of the three adult females was 76, two of these pelves being respectively 79 and 80. From the data which are furnished by Professor Flower in his table of pelvic measurements of this race the mean breadth of eight males was 212·1 mm., and the mean height was 175·5 mm., whilst the mean breadth of nine females was 203·8, and the mean height was 165·4. The breadth-height index for the men was therefore 82·7, and for the women 81, so that this index is, when a larger average is taken, higher in both sexes than would appear from my more limited series of measurements.

The specimen which is of most interest in the table of Asiatic pelves is the Malay, which, though on a considerably larger scale, approximated in the form of its ilium to that of the Bushman, and its breadth-height index was 85. C. Martin and H. Fritsch have both described pelves of Malays, and remark on the translucent character of the bone in the iliac fossa. Martin speaks of the Malay pelvis as narrow, and that the iliac spines and crest, in comparison with the antero-posterior diameter of the entire pelvis, are not far separated from each other, a character with which my specimen also corresponds.

The only entire male Guanche pelvis in my series had a breadth-height index of 77, and approximated therefore closely to the European standard. M. Verneau, who has examined both a male and female Guanche pelvis, stated that whilst the female differed very little, except in the pelvic inlet, from that of a European woman, the male on the other hand had strongly marked differences. Amongst these he says that the ilia were feebly developed and with not much of an incline, and that the greatest transverse diameter of the pelvis was considerable in relation to the vertical and antero-posterior diameters. He gives 81 as the breadth-height index of the male, and 75 as that of the female Guanche pelvis.

In both the male and female Esquimaux the breadth-height index was 77, and the pelves were large, well formed, and with moderately expanded iliac wings. Dr. Struthers, who many years ago described a female Esquimaux, stated that the diameter between the iliac crests was (11 inches) 280 mm., and between the anterior superior iliac spines (10 inches) 254 mm., so that its dimensions in these diameters were larger than either the male or female in my table. He does not, however, give the pelvic height, so that I am unable to compute a breadth-height index. M. Verneau has also examined an imperfect male pelvis of this race. The maximum breadth in it was only 245 mm., and the height 205, whilst the breadth-height index was 84. Verneau directs attention to the diminution in breadth of this pelvis from the iliac crests to the ischial tubera, whilst the antero-posterior and vertical diameters are, he says, but little modified. Whilst the iliac fossæ are very concave, the ilia are less developed, especially in the vertical direction. From the difference in the relation of breadth and height in Verneau's Esquimaux and in mine it is evident that we are not yet in a position to state what the general form of the pelvis is in this race.

The pelvis of the male Laplander had a breadth-height index of 80·5, and the female

of 75, numbers which closely approximate to the ordinary European average. Pruner-Bey was the first to describe a male Lapp pelvis, and the same specimen, together with another male, was redescribed by Verneau, who gave 76 as the breadth-height index of his two males. The pelvis was distinctly smaller in this race than in Europeans generally, though in the proportion of its two great dimensions it does not seem to differ very materially from the European average.

b. Pelvic Brim.

That the inlet to the true pelvis presented variations in outline and in the relative proportions of its conjugate and transverse diameters has been recognised by anatomists since the form of the pelvis in the different races of men began to be studied.[1] Thus Vrolik pointed out that in the Negro the conjugate diameter of the brim was very great, in proportion to the transverse diameter, when compared with the European. But the first to put these variations into systematic shape was Professor M. J. Weber of Bonn, who described four prime forms of pelvis, which he designated oval, round, four-sided, and wedge-shaped. In the oval pelvis the transverse diameter of the brim distinctly exceeded the conjugate, and the pelvic inlet was transversely ovoid; in the round pelvis the transverse and conjugate diameters were almost equal, and the pelvic inlet was circular; in the four-sided pelvis the transverse diameter exceeded the conjugate, and the sides and anterior and posterior boundaries of the pelvic brim were flattened so as to give it a quadrangular shape; in the wedge-shaped pelvis the inlet was laterally compressed, and the transverse diameter greatly reduced near the symphysis, so that the pubic bones joined at an acute angle, the conjugate diameter was therefore greater than the transverse, and the outline of the inlet was cuneiform. Although he recognised that differences existed in the dimensions of the conjugate and transverse diameters in the same pelvis, yet Weber did not give such a numerical expression to these differences as to enable them to be referred to a common standard. A few years afterwards von Stein divided the form of the pelvic inlet into four classes—truncated-cordate (abgestumpfte Kartenherzform); elliptical, where the transverse diameter is the larger; round; and elliptical, where the conjugate diameter is the larger. He stated also that one would be justified in speaking of a difference of breadth-index in the pelvis as in the skull. Like Weber he does not appear, however, to refer these differences to a common standard. This was, however, subsequently done by Professor Zaaijer of Leyden, who, in his important memoir on the form of the pelvis in the women of Java (1866), suggested that in order to give a fixed standard of comparison between the conjugate and transverse diameters, the transverse

[1] This section on the Index of the Pelvic Brim as a basis for the Classification of the Races of men, as well as that on the Sacrum, have had several additions and modifications made to them since the publication of my papers on these subjects in the *Journ. of Anat. and Phys.*, vol. xx., October 1885, and January 1886.

diameter should be regarded as equal to 100. Then by multiplying the conjugate diameter by 100 and dividing by the transverse diameter, the proportion which the conjugate diameter bore to 100, or in other words the pelvic or brim index was obtained. When these diameters bore to each other the relation of 100 to 90 or under, then he regarded the pelvic inlet as round. But when the conjugate was greater in relation to the transverse, he called it longish oval. About the same time Carl Martin published an account of his measurements of the female pelvis in Europeans, Negresses, Mulattos, Bushwomen, Malays, Melanesians, and one Australian woman. As a result of his measurements he grouped these female pelves into *a*, those with a round inlet, in which the conjugate was almost as large as the transverse diameter, or at the most one-tenth smaller; and in this group he placed the aboriginal Americans, Australians, Malays, and Pacific Islanders: and *b*, those with a transversely oval inlet, in which the conjugate was more than one-tenth smaller than the transverse diameter, and in this group he placed the pelves of European and African women, though the Europeans had the widest pelvic inlet.

The mode of estimating the brim or pelvic index after the formula of Professor Zaaijer has been adopted by the majority of anthropologists, though some would have preferred to have reversed his formula and to have taken the conjugate diameter as equal to 100.[1] This, indeed, was at one time the opinion of M. Topinard, though subsequently in his *Eléments d' Anthropologie générale*, he has conformed to the usual practice.

The attempts which were made by Zaaijer and Martin to frame a classification of the pelvis, either in the same or in different races, on modifications in the relative proportions of the conjugate and transverse diameters of the brim, were not successful and did not find much favour amongst anthropologists, so that one meets with but little reference to them in current literature. This failure is, I think, in a great measure to be accounted for partly by the paucity of the observations, but mainly because they based their calculations largely if not exclusively on the study of female pelves, in which, for sexual reasons, there is to a considerable extent an approximation in form in different races, so that one does not meet in them with such striking variations in shape as when one compares the male pelves in different races with each other. In the males, therefore, the form characteristic of the race is more fixed, and from their study it is, I think, possible to frame a classification of the pelvis.

There are two groups of measurements which, from their importance, might serve as a basis for such a classification, viz., *a*, the breadth and height of the entire pelvis, from which a breadth-height index, such as has been discussed in an earlier part of this chapter, can be computed; and *b*, the conjugate and transverse diameters of the pelvic brim, from which the pelvic or brim index can be calculated. There can, I think, be little doubt

[1] See for example Carl Martin's paper in *Corresp. Blatt. der deutsch. Gesellsch. f. Anthrop. Ethn. u. Urgesch.*, März, 1881.

that, if sufficiently reliable data are obtainable, a classification of the pelvis into readily recognisable groups would be extremely convenient, and would save much time and trouble in description. Craniologists must be for ever grateful to Anders Retzius for grouping the skulls of the races of men into the two great divisions of dolichocephalic and brachycephalic, whilst the separation from the more extreme forms of these groups of an intermediate or mesaticephalic division by Paul Broca has been of material service.

Owing to the paucity of pelves in our museums as compared with the number of crania of the best known races, we are not in a position to speak with so much certainty of the characteristic pelvic form as we are of the head form in so many races, but there is now I think, sufficient material belonging to a number of races to enable me to offer for the consideration of anthropologists a classification which may, I trust, be regarded as satisfactory.

The dimensions which I shall take as presenting, in my judgment, the most reliable data for comparison, are the conjugate and transverse diameters of the pelvic brim, and the classification will be based on the modifications in the range of the brim index —the so-called pelvic index. I shall not, however, as was done by Zaaijer and Martin, limit myself to a division into two groups, but shall make three divisions, two of which will represent extreme forms in opposite directions, whilst the third will be intermediate. I shall express these divisions in terms derived from the Greek, so that the nomenclature in pelvic classification may be as far as possible on the same lines as the well-known divisions of crania. Neither the ancient Greek nor Roman physicians appear to have recognised the pelvis as a chief division of the skeleton,[1] for they associated the sacrum and coccyx with the spine, and the innominate bones with the lower limbs. No word, therefore, was employed in ancient Greek to designate this part of the skeleton. But the term πέλλα or πέλλις, a bowl or pail, may be regarded as equivalent to the Latin pelvis.[2] The modern Greeks, however, designate the anatomical pelvis by the word λεκάνη, a dish;[3] if one were therefore to conjoin either with πέλλα, or λεκάνη, the prefix δολιχός, long, to express one extreme form, πλατύς, wide, to express the opposite form, and μεσαίτατος, middlemost, to expresss the intermediate condition, one would obtain descriptive terms to suit our purpose. By *dolichopellic* (*dolicholekanic*) is to be understood a pelvis in which the conjugate diameter of the brim is either longer than the transverse or approaches closely to it; by *platypellic*[4] (*platylekanic*), a pelvis in which the transverse diameter of the brim greatly exceeds the conjugate; by *mesatipellic* (*mesatilekanic*) a pelvis in which the transverse diameter is not so greatly in excess of the conjugate. It may not be possible in the present state of our know-

[1] Onomatologia anatomica, von Professor Joseph Hyrtl. Wien, 1880.

[2] Liddell and Scott's Greek English Lexicon. Kilian in his essay entitled "Das Stachelbecken" (Schilderung neuer Beckenform, Mannheim, 1854) employs the term πέλις in combination with ἀκάνθινος, akantho-pelys, pelvis spinosa, to express a pelvis with a sharp pectineal line or a process projecting from it.

[3] ΑΝΘΡΩΠΟΛΟΓΙΑ, ὑπὸ Γ. ΔΙΑΜΑΝΤΟΠΟΥΛΟΥ ΣΜΥΡΝΗ. 1880, p. 36.

[4] I have not used the word "brachypellic" ("brachylekanic") as I wished to bring out by the employment of the prefix πλατύς that relatively great width was the characteristic feature of this form of pelvic brim.

ledge to fix definitely the numerical limits of each group, as it may need a wider range of material for comparison, both as regards the races and the number of pelves in each race, than we at present possess. In any case, indeed, just as in the classification of crania, the numerical limits would be arbitrary; still it will be advisable to give to each division such a range as will in all probability include within it those pelves in a given race that present the characteristic form. For the present then, we will assume that pelves with a brim index above 95 are dolichopellic (dolicholekanic), that those with a brim index below 90 are platypellic (platylekanic), whilst those whose brim index ranges from 90 to 95, both inclusive, are mesatipellic (mesatilekanic). But it is quite possible that these limits may subsequently need some modification.

First, we will enquire into the value of the brim index in Europeans, and about them we are fortunate to possess a good deal of information, as the dimensions of the brim have been measured in numerous pelves in most of the principal nations. Thus if we take British pelves and reduce the measurements from inches to millimètres we find that of those measured by J. J. Watt, the males had a transverse diameter of 116 mm. (4 in. 6 lines.), and a conjugate of 102 mm. (4 in.) which gives a brim index 87·9; the females, again, had a transverse diameter 142 mm. (5 in. 6 lines) and a conjugate 124 mm. (4 in. 9 lines), giving a brim index 87·3. The pelves measured by John Wood gave for the males—transverse 120 mm., conjugate 103, the brim index being 85; and for the females—transverse 132 mm., conjugate 114, the brim index being 86. My own measurements of six males presumably Scotch,[1] gave a mean transverse diameter 127 mm. and a mean conjugate 98 mm., with a brim index 77; and of eleven females a mean transverse of 137 mm. and a mean conjugate of 109 mm., with a brim index 79. M. Verneau, in his table of the measurements of Europeans, presumably French, states that this index is 80 in the men and 78 in the women. Gegenbaur gives the mean dimensions of the brim in pelves presumably German as follows:[2]—for the males—transverse diameter 128, conjugate 108, the brim index being 84; for the females—transverse diameter 135, conjugate 116, the brim index being 85·9. W. H. Flower states that his measurements of eleven European males—the nationality not being specified—gave a pelvic index 81, and of fourteen females an index of about 78. In the measurements made by John Wood, Gegenbaur, and myself, the brim index in the male pelvis is a little below the brim index in the female, but in those measured by J. J. Watt, Verneau and Flower the brim index of the males somewhat exceeded the females. Additional observations on the pelvic brim in European women have been made by Garson, whose measurements give 80 as the brim index; by Navas, whose measurements of Spanish women furnish a brim index 81, and by C. Martin, whose measurements give 69 as the brim index of Irish women.

[1] The pelvis of J. Howieson, figured in Plate I., had the following dimensions: breadth 231 mm., height 217 mm., conjugate of brim 89 mm., transverse diameter of brim 129 mm., pelvic index 69.

[2] Lehrbuch der Anatomie des Menschen, p. 265, 1883.

Through the investigations of A. Weisbach we possess considerable information on the form and dimensions of the pelvis in ten of the races in the Austrian empire. His measurements were made on the unmacerated pelves of men between twenty and thirty years of age. The mean brim index in these races is as follows. The mean of eight South Slavs 81·5, of twelve Germans 82·5, of six Slowaks 84·1, of eight Czechs 84·3, of twenty Magyars 88·3, of twenty Italians 89·1, of thirteen Ruthenians 89·2, of five Gipsies 90·4, of eleven Poles 91·2, and of nine Roumanians 91·6.

The lowest mean brim index recorded in any European race or nation is 77 for the males in the Scottish pelvis, and 69 for the females in the Irish pelvis; and almost without exception this index amongst European races, both males and females, is below 90. The highest mean of these races is met with in the male Magyars with a brim index 88·3 in the male Italians with a brim index 89·1, and in the Ruthenians with a brim index 89·2, so that the European pelvis is platypellic (platylekanic). In three however of the races in the Austrian empire the mean brim index, as Weisbach's measurements show, rises above 90, viz., the Gipsies, Roumanians, and Poles. The Gipsies however are not a European race, and the Roumanians have in all probability a strong Oriental admixture. It may be, I think, a question whether the eleven pelves described by Weisbach as Polish, and to which he gives a mean brim index 91·2, were either altogether or in great part of a pure Sclavonic race, for the mean index of his eight South Slav pelves was only 81·5, and that of his eight Bohemian Czechs was 84·3. I do not consider therefore that the higher mean index of these so-called Polish pelves should interfere with the general statement already made that the European pelvis is platypellic (platylekanic).

In placing the European pelvis, both male and female, so far as it is represented by these nations, in the platypellic division, it is not of course to be understood that no individual European pelvis ever attains a brim index of 90 or upwards, but that the mean in both sexes is below 90, and as a rule is markedly below that number.

In the next place I shall speak of another type of pelvis, and shall begin by considering the brim index in the Australian pelvis. All the anatomists who have written on the characters of the male pelvis in this race agree in stating that the pelvic brim is narrow in its transverse diameter as compared with the conjugate. Professor Huxley, who was one of the first, if not the first, to give a numerical expression to these diameters in this race, gives the mean pelvic index of five males which he had measured as 101, and of one female as 87. In only one of these males was the transverse diameter in excess of the conjugate. In Ecker's Australian male the index was 100, in Keferstein's 95, and the mean index of the five Australian males in the Blumenbach collection, as measured by Spengel, was 92. In the single male Australian measured by M. Verneau the brim index was 98, and the mean of this index in two females was 80. Professor Flower, in his account of the osteology of the Andaman Islanders, incidentally stated that ten male

Australian pelves which he had measured, and which probably included the five pelves previously measured by Professor Huxley, and that measured by Dr. Barnard Davis, gave an average pelvic index of 98. From Dr. Garson's measurements of five Australian female pelves an index of 91 has been computed. In my series of six adult males, recorded in Table I., the mean brim index was 97, and in the only female 96; of the six males three exceeded 95, one of them very considerably so, and three were below that number.

There is now, I think, sufficient material before us to pronounce a definite opinion on the relative size of the transverse and conjugate diameters of the pelvic brim in both sexes of Australians. It is clear that in the women the transverse diameter is larger, and not unfrequently considerably larger, than the conjugate, so that the pelvic index is for the race relatively low. If we include M. Verneau's two female pelves, which, from their low index of 80, one might be disposed to doubt if they belonged to genuine Australians, the mean index of the nine females measured was 88·5, and, if we exclude these, it was 91·3; in either case being considerably above the European mean for the same sex, and placing the Australian female pelvis on the verge between the mesatipellic and platypellic groups. In the males, on the other hand, the conjugate diameter very often exceeds the transverse, and seldom falls much below it, and as the transverse diameter rapidly diminishes in the pubic region, a cuneiform pelvic brim is produced. The mean brim index of the twenty-four males measured by Ecker, Keferstein, Huxley, Spengel,[1] Verneau, Flower, and myself is 96·6, so that they distinctly belong to the dolichopellic (dolicholekanic) group.

Data for enabling one to obtain a knowledge of the brim index in the Bush race have been furnished by several anatomists. The brim measurements of five males have been recorded by Johannes Müller, Huxley, G. Fritsch, and myself, and of eight females by Vrolik, Müller, Huxley, Görtz, Verneau, and Fritsch.[2] In the females the transverse diameter in some specimens considerably exceeded the conjugate, thus in Verneau's table the mean of his two pelves, one of which was the well-known Hottentot Venus described by Cuvier, gave 87 mm. for the conjugate and 122 mm. for the transverse diameters, with a brim index therefore of 71; whilst in the woman Afandy, described by Görtz, the conjugate was 111 mm. and the transverse 110 mm., which give an index of 100·9. The mean brim index in the eight women was 89, which places the female pelvis in the highest term of the platypellic group, though individual specimens belonged to each of the three divisions. The male Bush pelves, again, showed a much smaller range of variation in the brim index, and the conjugate and transverse diameters were more nearly equal. The lowest index, 93, was in Fritsch's specimen, in which the conjugate diameter was 96 and the transverse 103 mm., and the highest index, 109, was

[1] Spengel's measurements of pelves in the Blumenbach collection at Göttingen, are given by Barnard Davis in the Supplement to his Thesaurus Craniorum in a Table opposite page 96.

[2] Professor Humphry gives in his treatise on the Human Skeleton, p. 106, the transverse and conjugate diameters of the pelvic brim in three Bush skeletons, but he does not state the sex.

in the pelvis recorded in my Table VI. The mean of the five males was 99·5, so that they have a well-marked dolichopellic character. Notwithstanding the high proportion of the conjugate to the transverse diameter, the shape of the brim, if I may judge of its form from my specimen, and from the two pelves figured by G. Fritsch, is not cuneiform, for the two pubic bones do not rapidly approximate to each other as in the Australian pelvis; in my pelvis the term antero-posteriorly oval properly expresses the form of the brim.[1]

The pelvic index of a male Hottentot measured by Jeffries Wyman was 94·4; but the fullest information that we possess on the pelvis of the Hottentots is contained in the valuable treatise on the aborigines of South Africa by Gustaf Fritsch. He puts the dimensions of the pelvic brim of a Hottentot woman at 96 mm. for the transverse diameter and 101 mm. for the conjugate, giving a brim index 105, which is remarkably high for the female pelvis. The transverse diameter of two male Korana Hottentots is respectively 105 and 91 mm., whilst the conjugate of the same is 96 and 108 mm., from which a brim index of 91·4 for the one and 118 for the other can be computed, giving a mean for the two of 104·7. So far then as we can judge from these few specimens, the Hottentot pelvis is dolichopellic. Fritsch also gives the measurements of six male and one female Kaffir pelvis, and from these measurements I have calculated their indices. The female, with a transverse diameter of 107 mm. and a conjugate of 96, had an index of 89·7, whilst the males varied in the brim index from 95 to 108, and had a mean of 100·6. Weber had also previously figured the pelvis of a male Kaffir, in which the transverse diameter of the brim was 3 in. 9 lines, the conjugate 4 inches, the brim index therefore was 102·6. He placed it in his wedge-shaped group. There can be no doubt, therefore, that the pelvis in the male Kaffirs is dolichopellic (dolicholekanic).

A considerable number of Negro pelves have now been measured. As a rule nothing definite has been stated, or, in all probability indeed, known of the exact districts or tribes from which most of these pelves were obtained, but Verneau in his essay especially mentions Nubia, Mozambique, and Guadeloupe as the localities from which certain of his specimens were derived. The measurements of the Negresses which have been described by Vrolik, Weber, J. Wood, Fritsch, Verneau, Martin, and myself amount to thirty-one, though it is possible that the same specimen may have been measured by more than one of these observers. The lowest brim index, 75·7, was that recorded by Fritsch, and the highest, 106, was the pelvis measured by John Wood; the mean of the series was 88·3. The measurements of the Negros described by von Sömmerring, Vrolik, John Wood, Huxley, Barnard Davis, Spengel, Verneau, and myself amounted to thirty-five, though with them it is also possible that the same pelvis may have had its

[1] Zuckerkandl states in his account of the skulls of the Novara Expedition (Wien, 1875), that the pelvis of a Bushman about fourteen years old had a tranverse diameter 9 cm. and a conjugate 8 cm. The brim index of this youth was 88·8.

measurements recorded by more than one observer.[1] The lowest brim index was 72, measured by Spengel, and the highest a male described by John Wood, with an index of 105, whilst the mean of the series was 92·7. In the male Negro, therefore, there was a greater difference as a rule between the transverse and conjugate diameters than in the Australians, Bush race, and Kaffirs, and the transverse diameter was proportionally wider. The males were mesatipellic, and the females were in the higher term of the platypellic division. The brim, therefore, as a rule, was not cuneiform, but had a more rounded outline.

The most extensive series of measurements of the pelvis of the Andaman Islanders has been given by Professor Flower in his memoir on their Osteology and in his Additional Observations thereon. His measurements of the pelvic brim gave a mean index in thirteen females of 96·4 and in twelve males of 98·8. Dr. Garson's measurements of apparently the same thirteen female pelves furnish the same mean index, 96·4. These numbers are higher than I got in my much more limited series, Table IV., where the three adult females had a mean brim index of 87 and the single adult male an index of 97. Notwithstanding these differences, it is, however, quite clear that, as the brim index was about 98 in the males, the pelvis in this sex was distinctly in the dolichopellic division. In the females, again, the index was lower, and, if the mean of Flower's and my observations be taken, it was 91·7, which places their pelvis in the mesatipellic (mesatilekanic) group.

In the Dresden Museum is the skeleton of a female Negrito from Palauan, Luzon, measured by Meyer and Tüngel, in which the pelvic brim has a transverse diameter 112 mm. and a conjugate 100 mm., the index being 89; in the same museum another Negrito female skeleton, from Bontoc, Luzon, called an Igorrote, has a transverse diameter of the brim of 122 mm., and a conjugate of 97 mm., the index being 79·5. M. Hamy, in his description of the skeleton of a female Negrito of the tribe of Aëta, from the neighbourhood of Binangonan, Luzon,[2] found the transverse diameter to be 112 mm., the conjugate 88 mm., and the brim index was only 78·5. In each of these three female Negritos the brim index was below 90, and the pelvis was platypellic. Von Franque described a female pelvis from Luzon, in the Semper collection in Würzburg, as that of a Papuan, but from the place where it was obtained it may have been a Negrito. Hennig, who has recently measured it, gives[3] the transverse diameter 115 mm., conjugate 105 mm., the brim index being 91, *i.e.*, it was mesatipellic. Another female pelvis often said to be that of a Negrito, in the museum at Halle, has been described both by H. Fritsch (Nonnulla de pelvibus), and by Hennig;[4] and the latter states that the transverse

[1] Professor Humphry in his treatise on the Human Skeleton (p. 106) states that the mean transverse diameter of twenty-five Negro pelves is 4·6 inches, the mean antero-posterior 4·1 inches; the calculated index therefore is 89. The sex of these skeletons is not stated, but probably both male and female.

[2] *Archives du Museum*, ser. 2, t. ii., 1879.

[3] *Sitzungsb. der Naturf. Ges. zu Leipzig*, May 11, 1880.

[4] *Op. cit.*

diameter is 117 mm., and the conjugate 100 mm., the brim index therefore is 85. A. B. Meyer, however doubts if this pelvis is that of a Negrito, and considers it to be a Negress.[1] It will be observed that all these pelves are those of women, and so far as I know no male Negrito pelvis from the Philippines has yet been described, although apparently a number of specimens are in German museums, so that the mean brim index of the male pelvis cannot at present be stated.

The measurements of a single male Nikobar Islander in the Berlin Museum have been given by Gustaf Fritsch in his Table II. The transverse diameter of the brim was 102 mm., the conjugate 91 mm., and the pelvic index was 89. It was therefore in the higher term of the platypellic division, but in all probability the mean index in this race will be found to be higher when a large average has been obtained.

Dr. Barnard Davis has given the dimensions of the pelvis in three male and one female Tasmanian skeleton. The pelvic index in the female was 83, and the mean index of the three males was 93·3. M. Verneau has recorded the measurements of a single male Tasmanian pelvis; its transverse diameter was 108 mm., its conjugate 95 mm., and its brim index 88. The mean of the four male pelves was 92, and not one exceeded 95, so that in all probability the Tasmanian pelvis is mesatipellic (mesatilekanic).

In the series of Papuan bones in the Dresden Museum collected by Dr. A. B. Meyer, near Rubi, Geelvinks Bay, New Guinea, are several sacra and innominate bones, and from these a male and a female pelvis have been artificially articulated. The dimensions of the brim of the male pelvis have been given both by Meyer and Tüngel and by Winckel as transverse diameter, 111 mm., conjugate, 107 mm., the pelvic index was therefore 96·4; those of the female pelvis as given by Winckel are transverse, 114 mm., conjugate, 106 mm., pelvic index 107·5. M. Verneau has stated the brim measurements in a female from New Guinea (erroneously marked male in his Synoptic Table), to be, transverse diameter, 136 mm., conjugate, 113 mm., with a brim index therefore of 83.

Of the smaller islands of the Pacific, M. Verneau has measured a fine series of pelves from New Caledonia, three of which were females and twelve males. The mean transverse diameter of the brim in three females was 123 mm., the mean conjugate 110 mm., and the brim index was 89. The mean transverse diameter in twelve males was 114, the mean conjugate 104 mm., and the brim index was 91. The same observer has recorded the transverse diameter of the brim in a male Loyalty Islander, from Lifu, as 116 mm. and the conjugate diameter as 124 mm., with a brim index 107. His two male Sandwich Islanders had a mean transverse diameter of the brim of 114 mm. and a mean conjugate of 92 mm. which yielded a brim index of 81, and the mean brim index in my three female Sandwich Islanders was 83. M. Verneau's male pelvis from Tonga had a transverse diameter of 126 mm. and a conjugate of 121 mm., with a brim index of 96; his male pelvis from Mangareva had a

[1] *Sitzungsb. der Naturf. Ges. zu Leipzig*, November 9, 1880.

transverse diameter of 119 mm. and a conjugate of 118 mm., with a brim index of 99; his male pelvis from Noukahiva had a transverse diameter of 108 mm. and a conjugate of 94 mm., with a brim index of 89. Dr. Barnard Davis has given the transverse diameter of the brim of a male dolichocephalic Loyalty Islander from Lifu (Awita) as 114 mm. and the conjugate as 106 mm., the index of which is 92; also the transverse diameter of a male brachycephalic Tannese[1] as 121 mm. and the conjugate as 110 mm., index 81. In my two New Zealand pelves the mean brim index was 96, and in a young Maori measured by Meyer and Tüngel it was 90·9.

There is therefore a wide range of variation in the relative transverse and conjugate diameters of the brim in the pelves of the Pacific Islanders, so that the index ranged, amongst the pelves measured, from 81 in a male Tannese and in a male Sandwich Islander to 107 in a male Loyalty Islander. This is in all probability to be accounted for in part at least from the fact that the series consisted of pelves, some of which were obtained from islands populated chiefly by the Melanesian race, others chiefly by the Polynesian or Mahori race, others again by a mixture of the two races.[2] The specimens which have been measured are too few and too doubtful as to the race to which they belonged to enable one to state with any certainty what is the characteristic form of the pelvic brim in each of these two great races, or the modifications which may arise in its form when the two races are intermingled. If one, however, may regard the pelves from New Caledonia as derived from the Melanesian race inhabiting that group of islands, then it would seem as if in the females the mean brim index did not reach 90, so that they belonged to the platypellic group, whilst in the males the same index was at or about 91, so that they were mesatipellic. On the other hand, however, in one of the male Loyalty Islanders, also in all probability of the Melanesian stock, the pelvic index was, as just stated, as high as 107, and therefore very strongly dolichopellic, and in both the male and female Papuan pelves in the Dresden Museum this index was also dolichopellic (dolicholekanic). Again, if one may regard the male pelves from Tonga, Mangareva, Noukahiva, and New Zealand as from people of the Polynesian or Mahori race, then it would seem as if this race had a higher brim index than the Melanesians of New Caledonia, and was either dolichopellic or approaching that group. On the other hand, it should be remembered that the brim index in Verneau's two male Sandwich Islanders and in Barnard Davis's brachycephalic Tannese was as low as 81, *i.e.*, platypellic.

One must still leave in doubt, therefore, the exact position of both Polynesians and Melanesians, but should the opinion which I have just expressed, that the male Melanesians are mesatipellic, be confirmed by a more extended series of observations,

[1] The length-breadth index of the skull of the Lifu Islander, Awita, is said by Dr. Barnard Davis to be 74, and that of the Tannese 85.

[2] For a resumé of the facts on which this statement of the distribution of the two great races of the Pacific is made, I may refer to the chapter on the Races of the Pacific Ocean in the First or Craniological Part of this Report.

then they would correspond in the form and proportions of the pelvic brim with the Negros rather than with the Australians, Bush race, Hottentots, Kaffirs, and Andaman Islanders, all of whom are distinctly dolichopellic. We may, however, look for much additional light on this matter when the observations which I understand Dr. Prochownick of Hamburg is making on the large series of pelves from the Pacific Islands in the Godeffroy Museum have been published.

In addition to the specimens of the pelves of the Guanche people recorded in my Table VI., M. Verneau has described the characters of a male and a female pelvis. Of the female he says that the inlet was very sensibly elongated antero-posteriorly, but on the contrary its transverse diameter was slightly diminished. With the exception of the inlet it differed very little from a European woman. The transverse diameter of the brim was 132 mm., the conjugate 120 mm., and the brim index was 91. In his male as in the female the transverse diameter of the brim only exceeded the antero-posterior by a few millimètres, and the brim index was also 91. In my perfect male pelvis the transverse diameter considerably exceeded the antero-posterior, the brim index was 85 and the form of the inlet approximated to the oval. The mean of the two males was 88, but the specimens are too few to enable one to state definitely to which of my three divisions of the pelvis this race should be referred, but in all probability it is either platypellic or mesatipellic.

The dimensions of the brim in an Esquimaux pelvis have been recorded by Dr. Struthers in a female specimen. He gives the conjugate diameter as ($4\frac{5}{8}$ inches) 117 mm. and the transverse as (6 inches) 153 mm., which furnish a brim index of 76, and show a pelvis which must have had a markedly transversely oval inlet. M. Verneau records the transverse diameter of the brim in his male pelvis as 124 mm., but it was too much damaged to enable him to obtain the conjugate dimension. In my two specimens (Table VII.) the brim index, 88 in the male and 84 in the female, closely corresponded to the mean index in Europeans of both sexes. It is probable that the Esquimaux therefore belong to the platypellic (platylekanic) group.

The two male Laplanders whose pelvic measurements are recorded by M. Verneau had a mean transverse diameter, 122 mm. and a mean conjugate diameter, 101, so that the brim index was 83. In my male specimen the transverse diameter was much smaller, both absolutely and relatively to the conjugate, and the brim index was 93. In my female, again, the transverse diameter of the brim was considerably in excess of the conjugate, and the pelvic index was only 72·5. The mean brim index of the three males was 88, and it is not unlikely that the male Lapp pelvis may, when additional observations are recorded, be found to be in the higher term of the platypellic group.

The Hindoo pelves recorded in Table V. had a brim index of 89 in the male and 93 in the female. A third Hindoo skeleton, that of a male,[1] which has been presented to

[1] This man was a Hindoo by religion, and believed to be a native of Bengal. In stature, as will be seen on p. 104, he was above the average height. See also remarks on p. 118.

the Anatomical Museum by Dr. John Anderson since Table V. was in type, had a transverse diameter, 133 mm., and a conjugate diameter, 117, giving a brim index 88. In the Sikh recorded in Table V. the index of the pelvic brim was 90; in the male Sikh, "Bariam Singh," measured by Barnard Davis, the transverse diameter of the brim was 125, the conjugate diameter 102 mm. and the pelvic index 81. In a male Bhutea, also measured by Barnard Davis, the transverse diameter of the brim is said to be 114 mm., the conjugate 112 mm., and the brim index 98. In a male pelvis described by M. Broca as a "black Hindoo," from the neighbourhood of Madras, the transverse diameter of the brim was 101 mm., and the conjugate 81 mm., the index therefore was 80; in a female from the same place the transverse diameter was 120 mm., the conjugate 117 mm., and the brim index 97·5. In a female Coolie described by Dr. Maurel the transverse diameter was 117 mm., and the antero-posterior 100 mm., the brim index being 85. The mean brim index of the five male natives of India was 87, *i.e.*, they were platypellic; whilst the mean of the three females was 91·8, *i.e.*, mesatipellic. The specimens were too few in number on which to frame an average, but in all probability when a large average is obtained both males and females will prove to be platypellic.

The Mongolian race is represented in my measurements in Table V. by a single Chinese pelvis, which, from the label attached to it, I have described as a male, though in the open subpubic angle, 76°, it approximated to the female character. Apparently only five Chinese pelves had previously been described, a female by von Franque, a male and female by Verneau, a male by J. W. Spengel, and a male in the Dresden Museum by A. B. Meyer and E. Tüngel. Verneau in addition gives an account of a male Annamite. Von Franque pointed out that it was scarcely possible to distinguish the pelvis of his Chinese woman from that of a European; the transverse diameter of the brim was 133 mm., and the conjugate 104 mm., so that the brim index was 78. Verneau stated that the inlet in the Chinese woman was very enlarged, very prominent, and had the form of a heart on a playing card; the transverse diameter of the brim was 140 mm. and the conjugate 89 mm., so that the brim index was only 64, being the lowest pelvic index recorded in his series of measurements. In his male Chinese the transverse diameter was 115 mm., the conjugate 93 mm., and the brim index was 81. Spengel's male had a transverse diameter, 112 mm., a conjugate diameter, 95 mm., pelvic index 85; the Dresden male had a transverse diameter, 114 mm., and a conjugate 92 mm., with an index 80·7. In my specimen the corresponding index was 85. All the six Chinese pelves now recorded, viz., four males and two females, had an index considerably below 90, so that there can, I think, be no doubt that the Chinese pelvis is platypellic. Verneau's Annamite male pelvis had an inlet 110 mm. in its transverse and 88 mm. in its antero-posterior diameter, with an index of 75, which strengthens the view that the Mongolian pelvis is platypellic (platylekanic).

Dönitz,[1] from the study of seven female Japanese pelves, came to the conclusion that two different types were to be found in them, the one with a round or heart-shaped inlet, the other with a transversely oval or wide brim. Those with a round or heart-shaped inlet Wernich regarded as belonging to the Malayan race, whilst those with a wide brim, approximating to the Europeans, he held to be a product of a cross between the Aïnos, the original inhabitants, and the Malays. If the conjugate diameter be regarded as equal to 100, the wide-brimmed pelves have a transverse diameter equal to 125, whilst in Europeans the corresponding diameter is equal to 127, but the pelves with a round or heart-shaped brim have a transverse diameter equal only to 107. Scheube[2] has measured a male Aïno pelvis and has given the transverse diameter of the brim as 113 mm. and the conjugate as 115 mm., which give a brim index 102. Barnard Davis's measurements of the pelvis of an Aïno woman were, transverse diameter 102 mm., conjugate diameter 117 mm., pelvic index 97. In the single specimen of each sex the brim index was above 95, so that it is possible that the Aïnos are dolichopellic. If these measurements of the Aïno pelvis are to be regarded as expressing the character of the race, it is difficult to see how a people with apparently dolichopellic proportions, by crossing with a race in which the conjugate diameter is also proportionately great, could produce a pelvis with a wide inlet.

The male Malayan pelvis recorded in my Table V. had an inlet which was ovoid in the antero-posterior diameter, and the brim index, 105, showed it to be highly dolichopellic. In von Franque's female Malay the transverse diameter was 126 mm., the conjugate 116 mm., and the brim index 92; the form of the inlet as in my specimen was antero-posteriorly oval. A female Kubu from Sumatra, probably of the Malay race, measured by J. G. Garson, had the brim 117 mm. in transverse diameter, and 122 mm. in the conjugate, with a brim index therefore 104·3, so that it was greatly elongated antero-posteriorly. The two male Javan pelves measured by Barnard Davis are, however, stated to have had a pelvic index of 83 and 81 respectively, *i.e.*, they were platypellic. In a female Javan pelvis measured by Verneau this index was 90. Zaaijer, from his analysis of the pelvic measurements of twenty-six Java women, stated that the form of the inlet was not uniform, in sixteen it was round, the transverse diameter being to the conjugate as 100 to 90 or under; in ten it was longish-oval, the transverse diameter being as 100 to more than 90. H. Fritsch has measured five female Malay pelves, and has described the pelvic inlet as round, with a relative predominance of the conjugate diameter. C. Martin has described the conjugate diameter as very long, the inlet round, in many examples oval. From the series of female Malay pelves described by Zaaijer, H. Fritsch, and himself, C. Martin has obtained a mean transverse diameter of 119 mm.

[1] Quoted by Ploss in *Archiv f. Anthropologie*, Bd. xv. p. 266, 1884, and by Wernich in *Archiv f. Gynäkologie*, Bd. xii. p. 293, 1877.

[2] Also quoted by Ploss.

and a mean conjugate of 109 mm., from which a brim index of 91·6 can be computed, so that they are mesatipellic (mesatilekanic). This is a high index for the female sex, and as experience has shown that in each race the brim index is as a rule distinctly higher in the male pelvis than in the female, it is not unlikely that the male pelves are dolichopellic, and the high index in my male specimen is probably a key to the dolichopellic (dolicholekanic) character of these people.

I have had no opportunity of examining any pelves of the Indian tribes of either North or South America. Very little, indeed, appears to be known of the pelvis in the North American Indians. Von Franque has described a male and female pelvis of Flat-head Indians from Vancouver Island, and from his measurements the brim index in the male was 76 and in the female 84·5. Barnard Davis gives the measurements of the pelvis of a male Illinois Indian, which had a transverse diameter, 127 mm., a conjugate, 110 mm., pelvic index 86. Verneau describes a female Mexican[1] with a transverse diameter 130 mm. and a conjugate 104 mm., the brim index being 80. The mean of the two males was 81, and that of the two females 82, so that both sexes were platypellic.

Weber, Barnard Davis and Verneau have all described specimens of the pelvis in various tribes of South American Indians. Weber figures the pelvis of a male Botocudo Indian, the transverse diameter of the brim in which was 4 in. 7 lines, the conjugate diameter 4 inches, which gave an index 85; also a female Botocudon, the transverse diameter in which was 4 in. 3 lines, the conjugate 4 in. 6 lines which give a pelvic index 107. He places the male in his group of pelves with an oval inlet, the female in his cuneiform group. Barnard Davis found a male Puelche Indian to have both the transverse and conjugate diameters of the brim equal at 116 mm., with an index therefore of 100, and an ancient male Peruvian with the transverse diameter considerably in excess of the conjugate, and with an index of 81. Verneau gave the transverse diameter of the brim in a male Charruan Indian as 122 mm. and the conjugate as 115 mm., the index being 94; also the transverse diameter of a male Botocudon as 123 mm. and the conjugate as 91 mm., the index being 74; also the transverse diameter of a male Goytacazen 119 mm. and the conjugate 89 mm., with an index 75, and of a female with an index 86; also the mean transverse diameter of two male Peruvians 135 mm. and the conjugate 91 mm., with a mean index 67, and three females with a mean index 83; also a male Bolivian with a transverse diameter 116 mm. and a conjugate 105 mm., the index being 90·5. The males measured by Verneau varied in the brim index from 67 in the Peruvians to 94 in the Charruan, with a mean on the six specimens of 80. The females were much more uniform in the brim index, with a mean on the four specimens of 84·5. They presented this peculiarity that the mean pelvic index in the female was higher than in the male, and that therefore the transverse diameter was not proportionally so much in excess of the conjugate. Carl Martin, from

[1] Although he refers to a male Mexican pelvis in the Museum, yet he does not give its measurements.

his own observations and those of von Franque, has given in his latest paper the mean transverse diameter of the brim in American aboriginal women at 127 mm. and the mean conjugate at 115, from which an index of 90·5 can be computed, which is considerably higher than the mean obtained from Verneau's measurements. The mean of the whole series of South American Indians, calculated from the specimens referred to in this paragraph, is 83·3 for the males and 91·6 for the females, so that the males are platypellic, the females mesatipellic. The mean dimensions of the pelvic brim in the Fuegians, as obtained by Garson's measurements of four male pelves of the Yahgan tribe, is transverse diameter 121·5 mm., and conjugate diameter 98 mm. The index therefore is 80·6, so that these islanders, like the male aborigines of the South American continent, are platypellic (platylekanic).

I shall now classify in three parallel columns the people or races whose pelvic brim index I have analysed in the preceding pages, both from my own observations and from those of other anatomists. For reasons to which I have already referred, I have not included the female pelvis in this classification and have based it entirely on the measurements of the male pelvis, though, as will be seen from the frequent references which I have made to the brim index in the female, I consider that it assists one in arriving at a conclusion as to the group in which the pelvis of each race should be placed. In those cases in which, from the few pelves which have been measured, or from the wide variations in the brim index, there is a doubt as to the group in which a people or race should be ranked I have appended a query.

TABLE VIII.

DOLICHOPELLIC or DOLICHOLEKANIC. *Brim Index above 95.*	MESATIPELLIC or MESATILEKANIC. *Brim Index 90–95.*	PLATYPELLIC or PLATYLEKANIC. *Brim Index below 90.*
Australians	Negros	British
Bushmen	Tasmanians	French
Hottentots	New Caledonians	Germans
Kaffirs	Melanesians †	Europeans generally
Andaman Islanders	...	Guanche †
Malays	...	Esquimaux †
Polynesians †	...	Laplanders †
New Zealanders †	...	Natives of India
Ainos †	...	Chinese
...	...	Mongolians generally
...	...	American Indians
...	...	Fuegians

How greatly the female pelvis is modified in the proportions of the pelvic brim in relation to the special sexual requirements is shown from the fact that in none of the

people or races, whose pelvic dimensions are analysed in sufficient numbers to enable one to obtain an average, does the female pelvis attain, in the mean of each race, dolichopellic proportions. Thus in the Australians and Andaman Islanders, and probably the Malays, whilst the males are dolichopellic the females are mesatipellic. In the Bush race the males are dolichopellic, the females platypellic. In the Kaffirs the males are dolichopellic, the females mesatipellic or platypellic. In the Negros and New Caledonians the males are mesatipellic, the females are platypellic. Amongst the Europeans with a platypellic male index the females are also platypellic. In the South American Indians, on the other hand, whilst the males are platypellic the females are mesatipellic. These modifications all signify that in each race or people the transverse diameter of the brim, the cavity, and the outlet is as a rule relatively, and indeed for the most part absolutely, wider in the female pelvis than in the male.

c. Sacrum.

A comparison of the several indices in the various tables will show that great variety existed in the relative length and breadth of the sacrum in the pelves measured. These variations may be expressed numerically by computing a sacral index by multiplying the breadth of the bone by 100, and dividing by the length. When the index was above 100 the breadth of the sacrum was greater than its length, whilst, when the index was below 100 the sacrum was longer, than broad. I propose to employ certain descriptive terms to express these differences in the relations of the length and breadth of this bone. As the Greek word ἱερὸν is the equivalent of the Latin sacrum, the term *dolichohieric* would express a sacrum which was longer than broad, whilst *platyhieric* would express a sacrum in which the breadth exceeded the length. The highest index in the series was found in the male Esquimaux, which reached the remarkable number 139, whilst in one of the Negresses the index was as low as 89. But the differences in the sacral index are not to be looked at only as regards their value in the pelvis in individuals, either male or female, but with reference to the question whether in some races of men the sacral index is not as a rule considerably higher than in other races. In the consideration of this question, as in that of the brim index, it is important to bear in mind that sex modifies the relative proportions of the parts, and that in women the sacrum as a rule is broader in proportion to its length than in men.

Amongst Europeans M. Verneau has given, in sixty-three men, the mean length of the sacrum as 105 mm. and the mean breadth at the base as 118 mm., and in thirty-five women the mean length as 101 mm. and the mean breadth as 116 mm. If an index be computed from these figures the males will be found to possess a sacral index of 112·4 and the females one of 114·8. From Görtz's measurements of the length and breadth of the sacrum in European women I have calculated an index of 118·9. Dr. Garson states

101 mm. as the mean length of the sacrum in fourteen European women, and the mean breadth as 118·3, which yield an index of 116·8, slightly higher than that furnished by M. Verneau's measurements, but not so high as those of Görtz. But from Carl Martin's measurements of sixteen pelves, presumably German, the sacral length was 100 mm., the breadth 105 mm., and the index therefore only 105. Weisbach in his essay, already referred to, on the pelvis of the men of the Austrian empire, has given the dimensions of the sacrum. As he measures the breadth of that bone at its base, on the level of the ilio-pectineal line, he does not select that part of the base which has the greatest breadth, and consequently the sacral index computed from his measurements is less than if the widest part of the base had been chosen, wherever it may happen to be. The sacral index in his specimens, on his mode of measurement, is as follows:—Czechs 102·6, Italians 100·9, Ruthenians 100·8, Magyars 99·1, Gipsies 97·3, South Slavs 96·5, Germans 95, Poles 94·9, Roumanians 94·5, Slowaks 90. The index in all these cases is undoubtedly lower than would have been the case if the sacral breadth had been taken in the same way as that which I have employed, so that I have little doubt that the great bulk of these pelves had, according to my mode of measurement, a sacral index above 100.[1] In Europeans, therefore, both males and females, the mean diameter of the base of the sacrum was greater than that of its long axis; or in other words it was platyhieric.

In the Australians, again, an opposite relation prevails. In only one of the six adult males measured in Table I. was the breadth of the sacrum at the base greater than its length, in two these diameters were equal, and in the remaining three the length exceeded the breadth. The mean sacral index, therefore, of the males was only 98, and in the single adult female this index was only 101. In a male measured by Kêferstein the index was 88, in one by Barnard Davis 90, and in five males measured by Spengel it was 111, 106, 97, 89, and 111 respectively. In the single male Australian measured by Verneau the sacral breadth at the base is stated to be 105 mm. and the length only 87 mm.; but the latter diameter is so small for an adult male of this race, that one is disposed to think there must be either some error in the table, or that the sacrum could not have been normal; the index furnished by these measurements, 120, is therefore exceptionally high. The sacral index of a female measured by Barnard Davis was 89, and the mean index computed from the two females measured by Verneau was 105·9, and the mean sacral index of the five women measured by Garson was 114. Excluding, therefore, M. Verneau's male pelvis for the reason given above, it is clear that in the Australian men the breadth of the sacrum was small in relation to its length, so that in a considerable proportion the index did not exceed 100, and the mean of the thirteen males was 98·5, i.e., they were dolichohieric. In the women, again, the sacrum was

[1] I have tested this by the measurement of several pelves, both European and Australian. In the Europeans the greatest width of the sacrum was from 2 to 9 mm. more than the width opposite the iliopectineal lines; in the Australian pelves the greatest width varied from 5 to 8 mm. more than the width opposite these lines.

relatively broader than long, though it did not attain the proportions reached in the European, for if we take the mean of the nine female pelves measured by B. Davis, Verneau, Garson, and myself, the sacral index was only 102·5.

The proportions of the sacrum have been recorded in two Bushmen by G. Fritsch; in the one the length was 95 mm. and the breadth 91 mm., the sacral index being 95·8, in the other[1] the length was 94 mm. and the breadth 83 mm., the sacral index being 88. These two specimens, conjoined with the sacral index, 98, of the male recorded in my Table VI., give the mean sacral index of three males as 94. Verneau's two Bushwomen had a mean sacral index of 100; Görtz's Bushwoman, Afandy, had a sacrum 87 mm. long and 90 mm. broad, the index being 103; whilst in an adult female recorded by G. Fritsch the sacral length was 97 mm. and the breadth 79 mm., the index being only 81. The mean of these four females was 94·7. There can, I think, be little doubt that it is the rule in the Bush race for the male sacrum to be longer than broad, *i.e.*, dolichohieric. It is not, however, quite so clear as to the relative proportion in the female, for although the mean of the four specimens is only 94·7, yet it will be observed that this low index is due to one of the specimens being only 81.

G. Fritsch has also recorded the sacral length and breadth in the pelves of some Hottentots and Kaffirs from which indices may be computed. In a Hottentot woman the length of the sacrum was 95 mm., its breadth at the base 81 mm., and its index was 85. In one male Korana Hottentot the sacral length was 95 mm., the breadth 90 mm., and the index 94·7; in another the length was 105 mm., the breadth 79 mm., and the index only 75. In Wyman's male Hottentot the sacral index was only 82. In all these specimens, therefore, the length of the sacrum exceeded the breadth, and the mean index of three males was 83·9. In the six male Kaffirs measured by Fritsch the highest sacral index was computed to be 106 and the lowest 82, the mean of the series being 92·8. In the single female the sacral length was 86 mm., the breadth 92 mm., and the index 107. In the male Kaffirs, therefore, the sacrum is as a rule longer than broad, and both in them and in the Hottentots it is dolichohieric.

In all the Negro pelves measured in my Table III. the breadth of the sacrum exceeded the length, and the mean sacral index of the four males was 114; but though in one of the Negresses the sacrum was longer than broad, in the other the relation was reversed, and the mean index in the two specimens was only 99. In one of Spengel's male Negros the sacral index was 114, in the other 97; whilst in a Negro from the Gaboon measured by Barnard Davis it was only 87. If we take, however, the series of twenty-two males described by M. Verneau from Guadeloupe, Mozambique, Nubia, or of unknown locality, the proportions are such as to give a mean sacral index of 97, whilst the seven females either from Guadeloupe or an unknown locality had a mean sacral index 105·5. In the Negress measured by G. Fritsch the sacral length was 93 mm., the breadth 86 mm., and

[1] This Bushman pelvis has had some of its characters described by Johannes Müller.

the index 92. The mean of the twenty-nine males measured by Verneau, Spengel, B. Davis, and myself gave a sacral index 106, *i.e.*, they were platyhieric. The mean of the ten females measured by Verneau, Fritsch, and myself was only 98·8; so far, therefore, as these specimens show, in the Negro race the sacrum presents the exceptional arrangement of being in the female not so broad in proportion to its length as in the male.

In the only adult male Andaman Islander, as well as in the three adult females in my Table IV., the breadth of the sacrum exceeded the length; the sacral index of the adult male was 114, that of a young male was 106; the mean index of the three adult females was 111 and the index of a young female was 96·5. In the series of eight male Andaman Islanders measured by Professor Flower the mean sacral length was 97·1 mm. and the mean width was 91·3 mm., the index being 94, and in the series of nine females the mean length of this bone was 89·7 mm. and the mean breadth was 95·2 mm., the index being 106. In the single male specimen described by Barnard Davis the sacral breadth was so much less than the length that the index was only 77. It is clear, therefore, that the high sacral index in my male pelvis was an individual peculiarity, and that it is the rule in the male Andaman Islander for the length to exceed the breadth, so that the bone in them is dolichohieric, but in the women it is platyhieric.

In the Negrito skeleton from Luzon in the Dresden Museum the sacral length was 98 mm. and the breadth 107 mm., the index being 109; and in the Igorrote pelvis also from Luzon in the same collection, the length was 100 mm. and the breadth 112 mm., with an index of 112. In M. Hamy's Aëta Negrito the sacrum was 76 mm. long, and 93 mm. wide, but it is noted that the diminished length was due to an anomalous form of the 5th vertebra, which was sensibly less than in a normal sacrum; the sacral index was 122. These skeletons were from women and the index was platyhieric.

In Fritsch's Nikobar Islander the sacral length was 101 mm. and the breadth 90 mm., the index therefore was 89, or dolichohieric.

The three male Tasmanians measured by Barnard Davis had a sacral index respectively of 92, 86, and 114, giving a mean of 97, so that the sacrum was dolichohieric; but in the single female the index was 104.

Winckel has measured seven sacra in the collection of Papuan bones in the Dresden Museum obtained by A. B. Meyer from Rubi, New Guinea, three of which were regarded as males and four females; one of the males had six vertebræ in the sacrum, so that I have disregarded its measurements, the other two were in length 99 and 112 mm., and in breadth 100 and 101 mm., the sacral index of these specimens being respectively 101·5 and 89. The females varied in length from 97 to 105 mm.,[1] and in breadth from 92 to 103 mm., the indices being respectively 87·6, 93, 94·8 and 100. In a male New Guinea pelvis recorded by M. Verneau the sacral index was 111·6. The mean sacral index of

[1] Winckel says (p. 87), 97 to 112, but from the tables (pp. 89, 90) 105 is the highest measurement recorded of the length of the sacrum.

the above three male pelves was 100, and of the four females 93·8. The females were dolichohieric, and the males slightly platyhieric.

In each of my five female pelves from Oahu, Sandwich Islands, the sacral breadth exceeded the length, and the mean index was 113, and in the Tonga Islander the index was 115. In M. Verneau's two Sandwich Island men the mean sacral index was also 113, and in his male Tongan it was 100. In his male Mangarevan the sacral index was 100·9, and in his Noukahivan it was 99. In Barnard Davis's male Tannese this index was 100. In each of my two male New Zealanders the sacral index was 96, but in the young, probably female, Maori measured by Meyer and Tüngel it was 110. In Verneau's male Loyalty Islander the sacral index was 107·7, and in Barnard Davis's male pelvis it was 103. In Verneau's series of New Caledonians the mean sacral index in the males was 102 and in the females 120. In this series of Pacific Islanders, the mean sacral index of the males was 102, and of the females 114, so that the sacral breadth is as a rule greater than the length, and the proportion of that bone is platyhieric. As has already been pointed out in the chapter on the pelvic brim (p. 40) it is difficult to differentiate which of the specimens are pure Melanesians, or pure Polynesians, or how far they are a mixture of the two races.

In my two male Guanche pelves the mean sacral index was 108·5, and in M. Verneau's male this index was 102. In my male Esquimaux the sacrum had the abnormal index of 139, whilst this index in the female was 106. In my male Laplander the sacral index was 106, in the female 112; but the mean index in M. Verneau's two male Lapps was only 92·6. The number of pelves of the Guanche, Esquimaux, and Laplanders is too small to form an average, but I think it not unlikely it will be found, that in each of these races it is the rule for the sacrum to be broader than long.

Of the natives of India the sacral index of the male Hindoo in Table V. was 109. The dimensions of the sacrum in the tall male Hindoo presented to the museum by Dr. Anderson were—length 110 mm., breadth 122 mm., the index being 111; in the female Hindoo the index was 127. In all therefore the sacrum was platyhieric. In my Sikh the sacral index was 124·5, but in a male Sikh, "Bariam Singh," measured by Barnard Davis this index was only 91. In a male Bhutea, also measured by B. Davis the sacral index was 93·6.

The Chinese measured in Table V. had a sacral index 98. In von Franque's female specimen the length and breadth of the sacrum were equally 111 mm., and the index was therefore 100. In Verneau's female pelvis the sacral index was 120, but in his male, owing to the great length of the sacrum, 134 mm.,[1] this index was only 78. In

[1] Verneau states that in the Annamite and male and female Chinese pelves the sacrum consists of six pieces. The Chinese woman, notwithstanding this, has a relatively broad sacrum; but if he has included the sixth piece in his measurements of the Chinese man and of the Annamite the low sacral index is accounted for. It is not unlikely that Spengel's specimen may have had a similar arrangement.

Spengel's male the sacrum had a still greater length, 139 mm., and its breadth was 108 mm., the index being 77·7. In Meyer and Tüngel's male Chinese in the Dresden Museum, the length was 102 mm. and the breadth 106 mm., the index being 104. The mean index in the two females was 110, and in the four males 89·4. Owing to the paucity of the specimens, and the wide diversity in the relative proportions of this bone in the pelves measured, due probably to certain of the specimens possessing six vertebræ in the sacrum, it would be difficult to state, even approximately, the mean sacral index; but from the information at present before one it is possible that in the male Chinese the length of the sacrum may exceed the breadth, though in the two males, in which only five vertebræ were in each bone, the mean index was 101. In Verneau's male Annamite, also, the sacral index was only 87·5, but here also the bone had six vertebræ.

The female Aïno in the Barnard Davis collection had a sacral index 91; whilst in the male Aïno, measured by Scheube, the length and breadth of this bone were equal at 115 mm. and the sacral index was 100.

In my male Malay the sacral index was 95. In von Franque's female the sacral length was 102 mm. and the breadth 100 mm., the index being therefore 98. In Barnard Davis's two male Javanese the sacral index was respectively 96 and 88, but in Verneau's female, owing to the remarkable shortness of the sacrum, 72 mm., this index rose to 145. Of the twenty-six Javanese female pelves, measured in Zaaijer's Table I., the length of the sacrum exceeded the breadth in eleven specimens, it was less than the breadth in fourteen specimens, and in one these two dimensions were equal. As it is the rule in the female pelvis for the sacrum to be relatively broader than in the male, there can, I think, be little doubt that, in the Malay race, the male sacrum is longer than it is broad, and that this bone is dolichohieric.

Of the North American Indians von Franque gives the length of the sacrum in the male Flathead as 112 mm. and the breadth as 114 mm., the index being 101·8; whilst in the female the length was 107 mm. and the breadth 108 mm., the index being 100·9. In Barnard Davis's male Illinois Indian the sacral index was 115·8, and in Verneau's female Mexican it was 108. Probably, therefore, in the North American aborigines the average breadth of the sacrum is more than the average length.

The dimensions of the sacrum have been recorded in a few more specimens of South than of North American Indians. In a male Puelche measured by Barnard Davis the sacral index was 95·8, and in a male ancient Peruvian it was 92. From Verneau's table of sacral measurements I have computed the sacral index in a male Charruan at 108, in a male Botocudon 117, in a male Bolivian 93, the mean of two male Peruvians 128, in a male Goytacazen 119; whilst the mean of three female Peruvians was 121·7, and in a female Goytacazen it was 110·5. Of the eight males three had a sacral index below 100, but the others were so much above 100 that the mean sacral index of the series was 107·5, and the mean of the four females was 116. The measurements recorded by

J. G. Garson of four male Yahgans from Tierra del Fuego gave a mean sacral length 103·2 mm., and a mean sacral breadth 112·2 mm., the mean sacral index being 109, and in each specimen this index was above 100. In the South American Indians, therefore, I have little doubt that the mean breadth of the sacrum exceeds the mean length, so that the aborigines both in the north and south of that continent, as well as the Fuegian Islanders, are platyhieric.

From this analysis of my own measurements and of those of other anatomists it is clear that the proportion of the length to the breadth of the sacrum varies in different races of mankind. In some it is the rule to find it longer than broad, in others broader than long. Although additional observations are still greatly needed, especially on some of the races, yet it seems possible to make a provisional arrangement of the races of men into two groups, according as the sacral index is below or above 100, and in Table IX., as in the preceding one based on the index of the pelvic brim, the proportions are estimated on the measurements in the male sex.

A comparison of Table VIII., framed on the index of the pelvic brim (p. 45), with Table IX. will show that in many instances a dolichopellic brim is conjoined with a dolichohieric sacrum. For example, this is the case in the Australians, Bushmen, Kaffirs, Andaman Islanders, Ainos, and Malays. Again, a platypellic brim is conjoined with a platyhieric sacrum, as in the Europeans, American Indians, and probably the Guanches, Lapps, and the Esquimaux. The pelves which I have arranged in the mesatipellic, or

TABLE IX.

DOLICHOHIERIC. *Sacral Index below* 100.	PLATYHIERIC. *Sacral Index above* 100.
Australians	Europeans
Bushmen	Negros
Hottentots	Melanesians †
Kaffirs	Polynesians †
Andaman Islanders	Hindoos
Tasmanians	Guanches †
Malays	Esquimaux †
Chinese †	Lapps †
Aino †	North American Indians
...	South American Indians
...	Fuegians

intermediate division, partly belong, as regards the proportions of the sacrum, as in the Negros, to the platyhieric group, and partly, as in the Tasmanians, to the dolichohieric group. As the width of the pelvic brim is materially influenced by the breadth of the

sacrum, it was only to be expected that a platypellic pelvis would have a relatively wide sacrum, and that a dolichopellic pelvis would have a relatively narrow sacrum. There are three races which have an anomalous position in these two tables, viz., the Chinese, the Melanesians, and the Polynesians. The Chinese with a platypellic brim, it will be observed, are placed with pelves in which the sacrum is longer than broad. The position, however, which the Chinese occupy in Table IX., can only be regarded as provisional, and when a larger series is examined, on the basis of only five sacral vertebræ being measured, it is not unlikely that their position in the table of sacral proportions will have to be altered. The position of the Melanesians and Polynesians in Table VIII. is also provisional, as a wider series of observations may require them to be transferred to another column in that table.

In connection with the relative dimensions of the conjugate and transverse diameters of the pelvic brim, and those of the length and breadth of the sacrum in the different races of men, a few words may appropriately be written on the corresponding relations in the pelvis in other mammals, at least in those which possess five vertebræ in the sacrum. In the Anthropoid Apes the length of the sacrum is considerably greater than its breadth. In two orangs, which I have measured, the mean sacral index was 87; in two chimpanzees the mean was 77, in a gorilla the index was 72, and in a gibbon 89. In an ox the sacral index was 87, and in a camel it was 89. In all these mammals the sacrum is hyperdolichohieric. The mean index of the pelvic brim in two chimpanzees was 133, and in two orangs 126; whilst in a single gorilla the index was 144, and in a gibbon 151. In an ox the pelvic index was 110, and in a camel it was 110·8. In these animals the conjugate diameter of the pelvic brim was materially greater than the transverse, *i.e.*, the index was hyperdolichopellic. When a human pelvis therefore is dolichopellic, and also dolichohieric, it corresponds in these characters with the more usual type of mammalian pelvis; and, as compared with the relations of parts met with in the Europeans, it possesses a degraded or animalised arrangement.

In the Australian from Perth the first coccygeal vertebra, and in that from Manly Cove the entire coccyx, was fused with the sacrum.[1] In the Bush pelvis two coccygeal vertebræ were fused with the sacrum, the anterior concavity of which was also slight. In the Sikh, one of the female Andaman Islanders, a Sandwich Island woman, the Guanche pelves, and the female Laplander, the first coccygeal vertebra was fused with the sacrum. In none of the Australian pelves did the sacrum possess more than a slight concavity anteriorly. As a rule, indeed, the whole series of sacra belonging to the pelves measured in the tables had a gentle anterior concavity, without much depth, but in the male Esquimaux the lowest two sacral vertebræ were more abruptly bent forward on the third sacral, so that the bone had a deep concavity in front. The change in the direction of

[1] To avoid any misunderstanding as regards my measurements of the length of the sacrum, I wish to state that when one or more coccygeal vertebræ were fused with the sacrum they were not included in the length of that bone.

the sacrum which produced the anterior concavity was usually in the body of the 3rd or 4th sacral, or in the plane of their junction, but more commonly in the 3rd vertebra. In two Sandwich and in two Andaman Islanders, however, the bend took place in the 2nd sacral vertebra. That the anterior concavity of the sacrum is slighter in the black races than in Europeans has been recognised by previous observers. Sir Richard Owen referred to it in his comparison of the spine of a European with those of a Negro and Australian.[1] M. Bacarisse had directed attention to it in his work on the sacrum,[2] and M. Hamy has spoken of it in his description of the skeleton of a Negrito woman.[3]

3. Minor Peculiarities in the Pelves.

I may now refer to some minor points in the anatomy of these pelves. The late Professor Kilian of Bonn, in an essay entitled Das Stachelbecken (pelvis spinosa, Akanthopelys),[4] described a condition of the pelvis occasionally occurring in European women, in which the ilio-pectineal line was raised into a knife-like edge, or had a distinct pointed process projecting from it. I examined my series of pelves with reference to this condition and found a sharp pectineal spinous process projecting upwards in a Sandwich Island woman, in a female Andaman Islander, and in a male Laplander. A similar projection, but blunted at the apex, was present in the Manly Cove and Riverina Australians, in the Sikh, and in a Negress; whilst a sharp pectineal line occurred in the Queensland Australian, a Negro, a male Hindoo, a female Andaman Islander, and one of the Guanche pelves. The pectineal spinous process projected from the ilio-pectineal line immediately internal to the pectineal eminence. In its position this process corresponded with the pectineal tubercle present in the pelves of Marsupials and Monotremes.

Professor Zaaijer, in his memoir on the pelvis in the women of Java, already so frequently referred to, has called attention (p. 28) to a sulcus situated immediately anterior to the auricular surface of the ilium for articulation with the sacrum, which he has named *sulcus præauricularis*. It was present in twenty-three of his specimens and was wanting only in three, but it varied both in breadth and depth. On examining forty-one European iliac bones he found it present but not strongly developed in seven specimens, just indicated in four bones, and entirely wanting in thirty specimens. He considers that it is associated with the attachment of the anterior sacro-iliac ligaments. In my series of pelves I find it present in most of the Australian pelves, in the Bush, Sandwich Islanders, one of the New Zealanders, a Negro, Hindoo, Chinese, Malay, in the Andaman Islanders, Guanche, Laplanders, and Esquimaux. I have also seen it in several

[1] *Trans. Zool. Soc. Lond.*, vol. iv. p. 113.

[2] I regret that I have been unable to obtain a copy of M. Bacarisse's thesis on the sacrum; my knowledge of it is therefore solely derived from references in the writings of other anthropologists.

[3] Étude sur un Squelette d'Aëta; *Nouvelles Archives du Muséum*, ser. 2, t. ii., Paris, 1879.

[4] Schilderung neuer Beckenform, Mannheim, 1854.

European pelves, without being able, however, to state its relative frequency. It varied in its distinctness in different pelves; sometimes it was a narrow, shallow, vertical groove, so faint as to be just recognisable, in others the groove had considerable depth; sometimes it was widened out into a shallow fossa, but in others the fossa was deep. The most distinct examples of the sulcus præauricularis were found in the pelves of the Sandwich Island women. From its presence in so many races it cannot be regarded as a special character of any particular race.

Comparative views of the pelvis in various races of men have been figured by Vrolik, Weber, von Franque, G. Fritsch, and Verneau, but it has not been the custom to represent the different specimens figured according to a uniform plan, so that it is difficult to compare the figures of one observer with those of another. It would be very desirable therefore to establish some uniform method of representing the pelvis, so that, in the absence of the specimens themselves, a comparison may be instituted between the published figures of this part of the skeleton. The most natural position in which to place the pelvis for purposes of illustration would obviously be that which it occupies in the erect position of the human body. Professor G. H. Meyer, of Zurich, who has carefully inquired into this matter,[1] states that, in the erect attitude, the anterior superior spines of the ilium, along with the spines of the pubic bones, lie in the same vertical plane. This view of the normal position of the pelvis in the erect attitude has been confirmed by Dr. Prochownick of Hamburg, who has controlled it by measurements on living persons. Although it is possible that these spines may possess individual variations, as regards the vertical plane, within certain limits amongst Europeans, or between Europeans and other races, yet it is obviously an advantage to have in the illustrations of the pelvis a certain fixed standard of comparison.

The series of figures of the pelvis which illustrate this Report (Plates I., II., III.) have therefore all been made from pelves which have been so placed that both the pubic and antero-superior iliac spines were in the same vertical plane. The drawings are all strictly comparable with each other, and an inspection of them will show not only the modifications in the inclination of the ilium and in the form of the pelvic brim but some other differences. The cotyloid cavity, for example, varies in its inclination. As a rule it is directed outwards and concealed by the os pubis, but in the pelvis of the Andaman Islander, the Esquimaux, Guanche, Laplander, and Bushman it partly appears from under cover of the pubis, and in the Sandwich Island woman it comes very considerably into view. The direction of the pubic arch also is not uniform. In the male Australian, Negro, Sikh, and Andaman Islander, for example, the rami are in this position —that of the erect attitude—so directed backwards, that but little of the arch is visible; whilst in the female Sandwich Islander, the male Malay, and Esquimaux the arch approaches nearer to the vertical and is much more seen. Differences in the direction

[1] Lehrbuch der Physiologischen Anatomie des Menschen, p. 119, Leipsic, 1856.

and inclination of the sacrum in certain of the pelves are also well marked. Compare for example, the pelvis of the Scotsman with that of the Australian, and the pelvis of the Sikh with that of the Malay. It will also be noticed that the apex of the sacrum is on a much higher plane, as regards the upper border of the pubic symphisis, in certain pelves than in others; compare, *e.g.*, the Scotsman and Sikh with the Oahuan. I direct attention to these various points so that those who may have additional specimens for examination may test in how far they are racial, or only individual characters.

4. Age Characters of Pelvis.

Various anatomists have pointed out that when the pelvis of the new-born infant, or the child, is compared with that of the adult of either sex, important differences in the form and proportions of the pelvic brim can be seen. In the child the lateral boundary of the brim is not so concave relatively to the rest as in the adult, the opposite sides are more nearly parallel to each other, and the transverse diameter is proportionally less than the conjugate. From the observations of Litzmann on the pelvis in European children it would appear that, up to the age of thirteen, the transverse diameter of the brim very slightly exceeds, and indeed is occasionally less than the conjugate, but after that age it is constantly greater. He has given the following comparative statement of the differences in the proportions in the new-born infant and adult in the two sexes, the conjugate diameter being regarded as equal to 1·00; transverse diameter in male infant 1·11, in male adult 1·294; transverse diameter in female infant 1·07, in adult 1·292. Differences also occur at the base of the sacrum, in which bone the wings grow proportionally more than the body of the bone. Litzmann states that whilst in the new-born child the wings of the 1st sacral vertebra are scarcely half as broad as its body (male 0·45 to 1, female 0·46 to 1); in a man the mean proportion is 0·56 to 1; in a woman 0·76 to 1. During growth the body of this vertebra increases not quite three times in width, whilst the wings in a woman increase nearly five times, and in a man three and a half times. The sacrum in the adult has its base projected further forward than in the child, and its anterior surface is more concave, the beginning of the curvature being usually in the middle of the 3rd vertebra.

In the skeletons of the coloured races described in this Report I have estimated the proportion of the breadth of the body of the 1st sacral vertebra to the greatest breadth of that bone. The mean breadth of the sacrum in the six male Australians was 103·6 mm., and the mean breadth of the body of the 1st sacral vertebra was 49 mm., so that the latter had to the former the proportion of 47·2 to 100. In the single female the proportion was remarkably small, being only 37 to 100. In the five Sandwich Island women the mean breadth of the sacrum was 112·6, and that of the body of the 1st sacral vertebra 51·4, the proportion between the two being 45·6 to 100. In the Tonga Islander the proportion

was 40·5 to 100, and the mean of two Maoris was 48 to 100. In the Negros the proportion was 45·4 to 100, and in the Negresses 49 to 100. In the adult male Andaman Islander the proportion was 40·6 to 100, and the mean in the females was the same. In the male Bush the proportion was 53 to 100. The mean proportion in two male Hindoos was 45·6, and in a single female 43·6 to 100. In the Sikh it was 47·9, in the Malay 47, and in the Chinese 53·7 to 100. In the male Guanche the proportion was 44, and in the female 40·5; in the male Esquimaux 49, and in the female 38·8; in the male Lapp 54·9, and in the female 48 to 100. In not a single skeleton did the proportion of the breadth of the body of the 1st sacral vertebra to the entire breadth equal the mean proportion in the Europeans as given by Litzmann, and in the majority of cases fell much below it.

The changes in the form and proportions of the pelvis during its growth have been ascribed to various forces acting upon the bones when in a comparatively flexible and plastic condition, *e.g.*, the downward pressure of the weight of the trunk on the sacrum, the pressure of the heads of the femora on the cotyloid cavities when the body is standing erect, the action of the muscles attached to the bones, and the pressure on the pelvic walls of the viscera which are developed in the pelvic cavity. Of these forces the first two are without doubt those which operate most efficiently. It would be out of place to discuss in this Report their mode of operation as two opposing forces, and the more so as the argument has been stated with great clearness and force by Dr. J. Matthews Duncan in his Researches in Obstetrics.[1] I would merely add as corroborative of his statement that the heads of the thigh bones exercise an inward and upward pressure on the walls of the pelvis in the region of the acetabula, that in a number of pelves, both European and exotic, I have seen a distinct bulging of the pelvic wall towards the cavity immediately internal to the acetabula, so that the transverse diameter of the cavity at this spot is diminished by several millemètres.

In the adult pelvis the greatest transverse diameter of the inlet is at a point between the anterior border of the base of the sacrum and a vertical transverse plane through the middle of the acetabula, but somewhat nearer the sacrum than the acetabula. If my tables of measurements of the various pelves be examined, it will be seen that the transverse diameter of the brim exceeded the greatest breadth of the base of the sacrum in the great majority of the specimens. Sometimes, however, in a male pelvis the sacral breadth was more than that of the transverse diameter of the inlet. This was the case in one Australian, two Negros, a young Andaman Islander, and one Bushman. In a male Hindoo the two dimensions were equal.

In all my adult pelves in which the conjugate diameter exceeded, or was almost the same as the transverse, *i.e.*, in the dolichopellic and mesatipellic series, the pelvic inlet approximated more closely to the infantile form than was the case in the platypellic series; and in such black races as the Australians and the Bush, the pelvic inlet was

[1] Edinburgh, 1868. See especially his chapter on the Development of the Pelvis.

more child-like than in the Europeans. This lack of proportional expansion in the transverse diameter was more strongly shown in the men than in the women; so that in the passage of the pelvis from the infantile to the adult stage of growth an opposite condition prevails to that presented by the skull, in which the man departs more widely from the infantile condition than does the woman.

But, as has been previously stated (p. 53), a pelvis with a conjugate diameter relatively long when compared with the transverse has a more animal form than one in which the opposite condition exists. In a quadruped the downward pressure exercised by the weight of the trunk on the sacrum is necessarily not of the same intensity as in the biped; though in the quadruped the upward pressure of the hind limbs, acting as pillars of support against the side walls of the pelvis in the region of the acetabula, must exercise an influence, in controlling the expansion of the pelvis in the transverse diameter, during its growth and when flexible and plastic. In the Anthropoid Apes also, in which the position of the body is intermediate between the quadruped and the erect attitude of man, the pressure of the weight of the trunk on the sacrum would, when the animal is standing, be diminished owing to the upper limbs being so frequently used as organs of support and progression.

The question therefore arises, is there anything in the habits and mode of life of the black races in their aboriginal state, which, by operating during childhood, could modify the vertical pressure of the weight of the trunk, and thus diminish the effect of one of the chief forces concerned in increasing the transverse diameter of the pelvic brim. It may be difficult to answer this question, but I would suggest the following as a not improbable explanation. A favourite attitude of many savages is that of "squatting," *i.e.*, with the ankles, knees and hip-joints acutely flexed, with the trunk bent forward, with the back of the thigh supported by the calf of the leg, or with the nates resting on the heels.[1] In this position the arms are conveniently supported on the knees in front of the thighs. The aboriginal Australian does not "squat," buts sits directly on the ground, bending his trunk forwards and embracing his knees with his arms. The trunk so long as this position is maintained would have a portion of its weight supported by the upper limbs, and the pressure on the sacrum and pelvis would be diminished so as to approximate the conditions somewhat to those of the Anthropoid Apes. But further, the savage when in pursuit of game often assumes a stooping or crouching attitude, in which the trunk is bent forward and its weight is directed obliquely backwards and downwards on to the base of the sacrum. Hence, both when at rest and when in active movement, his spine is made to bend forward, and its axis is not retained so much in the vertical position as in the white man, who, whether sitting, standing, or walking, erects the axis of his spine upon the pelvis.

[1] In Scotland and the north of England this attitude is designated by the expression "to sit on his hunkers." It is a favourite attitude with miners, and is named by them "hunkering down," and they are able to remain in it for a considerable length of time without fatigue.

SPINAL COLUMN.

In the chapter on the pelvis I have described the characters of the sacrum in forty specimens. In thirty of the skeletons tabulated in that chapter, the portion of the spine formed by the movable vertebræ was, with few exceptions, complete, so that I have been enabled to examine the vertebræ in the cervical, dorsal and lumbar regions, with the view of ascertaining if they presented any peculiarities either in form, arrangement, or manner of development. I shall now summarize the results of this examination.

Peculiarities of Individual Vertebræ.

The cervical region was to a large extent free from variations from the recognised arrangements based on the study of the skeletons of Europeans as described in the text books, but occasional departures from the usual description were met with. To these I shall now refer. In the Otago skeleton, the Chinese, two Hindoos, two Negros and two Andaman Islanders, the spine of the 6th cervical approximated in length to that of the 7th, and like it was not bifid. In the female Hindoo it was not bifid, but had no unusual length; in the female Lapp it was rudimentary and not bifid. In the Bushman the spines of the 3d, 6th, and 7th cervicals were not bifid, those of the 3d and 6th were short and stunted, that of the 7th as usual prominent. In a Negress only the spine of the axis was bifid and in a Negro the 3d, 4th, and 7th cervical spines were not bifid. In one of the Oahuan skeletons the 7th cervical spine was bifid. That in the lower races of men a tendency exists for the spines of the cervical vertebra to be more simple than in Europeans was recognised by Sir Richard Owen, who refers to the non-bifid character of the five lower spines in the skeletons of a Bushman and an Australian.[1] M. Hamy, in his memoir on the skeleton of a Negrito, states[2] that the spine was not bifid in the 6th cervical in some skeletons of the Oceanic and African black races, and that in an Australian a similar condition was met with as high as the 4th cervical: moreover, the skeletons of a Bushwoman, a Hottentot, and a Negress had only the spine of the axis bifid, and in the Aëta Negrito an almost similar arrangement was present.[3] The lengthening of the spine of the 6th cervical in many skeletons of the lower races of men has not had much attention given to it, though Owen states that in an Australian the 6th cervical spine was of greater length than the 5th.

In the Sikh skeleton the right vertebral groove on the atlas was bridged over by a bar of bone, and in two Hindoos and a Negress this groove was deepened by a pro-

[1] See his Memoir on the Vertebral Column of *Troglodytes* and *Pithecus*, in *Trans. Zool. Soc. Lond.*, vol. iv.

[2] *Nouv. Archives du Muséum*, ser. 2, tom. ii. 1879.

[3] Since this Report was in type Dr. D. J. Cunningham has published (*Journ. of Anat. and Phys.*, July 1886), observations on the comparative frequency of want of bifidity in the cervical spines in different races of men.

jection from the superior articular process. In an Australian the axis and 3d cervical were conjoined, also the 6th and 7th. In another Australian the left anterior transverse process of the 5th cervical gave off a descending process which articulated with the anterior transverse process of the 6th cervical. In the female Lapp the left half of the neural arch of the atlas was imperfect, owing to a defect in the ossification of the lamina. No skeleton possessed a movable cervical rib.

The dorsal region was, amongst other points, examined with reference to the costal articulations on the sides of the bodies of the vertebræ. In five Australians, two Hindoos, two Negresses, three Andaman Islanders, two Oahuans, two Esquimaux, a Malay, a Negro, a female Lapp, and the right side of the Sikh, the 12th, 11th, and 10th dorsal vertebræ articulated laterally, each with the head of only one rib, the facet on the 10th vertebra being for the lower part of the head of the 10th rib, the upper part of which articulated with the 9th vertebra. In two Negros, a Bush, a Maori, a Chinese, a Hindoo, an Andaman Islander, a male Lapp, and the left side of the Sikh, the 9th, 10th, 11th, and 12th dorsals articulated laterally, each with the head of only one rib; the facet on the 9th vertebra being for the lower part of the head of the corresponding rib, the upper part of which articulated with the 8th vertebra. In one Australian skeleton, only the 10th and 11th vertebræ had a single costal facet on each side, and the vertebra which represented the 12th, although with rudimentary transverse processes, had no costal facet on either side. In the great majority of the skeletons the inferior costal facet on the side of the body in the upper and middle series of dorsal vertebræ was raised from the general surface of the body as a *costal process*, but the superior facet was more in the general plane of the side of the body of the vertebra. In several skeletons, more especially the Australians, the transverse process of the 10th dorsal had no articular facet for the tubercle of the rib.

The mammillary processes were present in the 12th dorsal vertebra of each skeleton, and in many of the specimens these processes were larger than is the rule in Europeans, though sometimes one finds them very distinct in a European skeleton. In several Australians, the Maori, Chinese, Sikh, a Hindoo, Negro, Andaman Islander and Oahuan they were also distinct in the 11th dorsal, and in the Maori skeleton they could be seen as high as the 9th dorsal. Accessory processes were also recognised in many of the skeletons on both the 11th and 12th dorsals.

In three skeletons, viz., two Australians and an Esquimaux, an additional vertebra was interposed at the junction of the dorsal and lumbar regions. In the Eucla Australian it had a small articular facet on the side of each pedicle, obviously for the head of a rudimentary 13th rib. Its transverse processes were stunted as in the 12th dorsal, and there was on each side a large mammillary and a rudimentary accessory process. Its spinous process was shaped like the spine of a lumbar vertebra, and whilst its superior articular processes were shaped like those of a dorsal, its inferior pair were after the pattern of a

lumbar vertebra. In the West Victoria Australian skeleton the supernumerary vertebra had a small articular facet on the side of the right pedicle, for the head of a supplementary rib, but none on the left side. The transverse processes were stunted as in the 12th dorsal, and there was a distinct mammillary process. The spinous process was like that of the 12th dorsal but somewhat larger; both the upper and lower articular processes were like those of a lumbar vertebra. In the female Esquimaux the additional vertebra had a relatively large facet for the head of a rib on the left pedicle, and a smaller facet on the right pedicle. The transverse processes were stunted, and there were large mammillary and rudimentary accessory tubercles. The spine was transitional in shape

FIG. 1.—Anterior surface of the bodies of the 9th, 10th and 11th dorsal vertebræ of a Maori skeleton, to show the imperfect development of the body of the 10th dorsal.

between those of the 12th dorsal and 1st lumbar; the superior and inferior articular processes had the lumbar character.

A most remarkable anomaly in the development of the dorsal vertebræ occurred in the Maori skeleton from Otago (fig. 1). The 10th dorsal vertebra showed a great defect in the ossification of the body, which was divided by a mesial cleft into two lateral parts, the right of which was somewhat bigger than the left. The cleft passed from the anterior surface through the body to the spinal canal, also from the upper to the lower surface, and was 18 mm. wide in front and only 2 mm. wide behind. Each part of the body consisted of a wedge-shaped bar of bone, sloping both from without inwards and from

above downwards, the apex of the wedge being anterior. The wedge was continuous by its base with the pedicle of its own side, and was marked laterally by the articular facet for the head of the 10th rib. The bodies of the 9th and 11th dorsals had a greater vertical diameter in front than is usual, so as partially to occupy the cleft between the separated parts of the body of the 10th, but the rest of the interval had doubtless been occupied in the recent spine by intervertebral disc. Owing to this defect in the body of the 10th dorsal vertebra it is probable that a slight posterior or angular curvature had been present during life in the lower dorsal region.

There can of course be no doubt that in the 10th dorsal vertebra of this skeleton each of the two parts of its body had developed from a distinct lateral ossific nucleus instead of from a mesial nucleus, according to the normal arrangement; and the lateral centres must have been separated by a considerable interval in the fœtal spine, so as to allow of the relatively wide gap between the two wedge-shaped parts of the bone. It is possible that in the fœtal cartilaginous spine the cartilage also may have been divided into two lateral parts not united mesially. This remarkable anomaly in the ossification of a vertebra is very rare, but the case is not unique. Rokitansky has described[1] the 12th dorsal vertebra in a woman, age 55, as divided into two triangular rudiments, inserted laterally between the 11th dorsal and 1st lumbar vertebra, with their points directed inwards, and in consequence of the mesial defect in the body of this vertebra the column was bent backward at a very obtuse angle. Humphry saw in a specimen of spina bifida in the Berlin Museum[2] several of the vertebral bodies consisting of two halves with an opening between the two. Ahlfeld also refers[3] to a case observed by Ammon, in which the bodies of the 12th dorsal and 1st and 2nd lumbars consisted of two lateral halves. An approximation to this condition existed also in the vertebral columns described by Sandifort,[4] Otto,[5] and Rokitansky,[6] in which only one lateral half of a particular vertebra was developed; in both Sandifort's and Otto's cases the half of the vertebral body which was present is described as wedge-shaped.

The lumbar vertebræ had, as a rule, well-marked mammillary processes, but those on the 5th lumbar were not, for the most part, so large as on the four others. Accessory processes were usually present, but their relative size varied in the different skeletons. In the Malay, a Hindoo, and a Lapp, they were strongest in the 1st lumbar; in an Australian, Hindoo, Oahuan, and two Andaman Islanders, they were best marked in the 3rd lumbar, in a Negro in the 4th lumbar. In some of the skeletons the four upper lumbars, in others only the three upper had them distinctly marked. The size of both the mammillary and accessory processes is, without doubt, correlated with the development of those deep muscles of the back which are attached to them.

[1] Pathological Anatomy, *Syd. Soc. Trans.*, vol. iii. p. 232.
[2] Human Skeleton, p. 124.
[3] Die Missbildungen des Menschen, p. 296, 1882.
[4] Museum anatomicum, vol. iv. p. 74, Tab. clxxviii. fig. 2.
[5] Seltene Beobachtungen, zweite Sammlung, § 15.
[6] *Op. cit.*, p. 231.

The transverse processes of the 1st lumbar vertebra were short and rudimentary in an Australian, a Sandwich Islander, and the Malay. These processes were relatively short in the four upper lumbar vertebræ of the Chinese. In the spine of the Sikh these processes in the 3rd lumbar were very long. In one of the Andaman Islanders and two Australians one or both transverse processes of the 5th lumbar articulated with the base of the sacrum. In another Andaman Islander the inferior articular process of the last lumbar was prolonged outwards, especially on the right side, so as almost to reach the transverse process.

In the Queensland skeleton the body of the 5th lumbar had been modified in its development, though not to the same extent as the 10th dorsal vertebra in the Maori skeleton from Otago (fig. 1). Its anterior, upper, and lower surfaces were grooved a little to the left side of the mesial plane, so as to give the appearance of a division of the body into a right and left lateral wedge-shaped portion, of which the right was the larger. These divisions had, however, fused together, so that they were not separated by a mesial cleft; the body had thus the appearance of having been developed from two originally distinct lateral centres, which had subsequently fused together.

Imperfections in the development of the neural arch of the 5th lumbar vertebra were not unfrequent. In a male Andaman Islander, and in the Chinese, the right and left halves of the lumbar spine had not united mesially. In five skeletons the part of the neural arch which formed the two laminæ, the spine and the inferior pair of articular

Fig. 2.—Fifth lumbar vertebra from a Malay skeleton, showing the divided condition of the laminar part of the arch.

processes, had been developed independently of the part of the arch which formed the two peduncles, the transverse processes and the superior pair of articular processes. This irregular development was seen in its most pronounced form in the Malay skeleton, in which not only the lamina and inferior articular process on each side formed a plate

of bone quite separate from the peduncle, transverse process, and superior articular process; but the two laminæ, not united mesially and posteriorly into a single spine, were separated from each other by a mesial cleft (fig. 2). In both the Bushman and the male Esquimaux the laminæ had united posteriorly into a mesial spine, but they and the inferior articular processes were not fused with the pedicles, so that the posterior part of the neural arch formed a separate piece of bone. The very imperfect spine of a Sandwich Islander, recently presented by Dr. G. W. Parker of Waiahia, Oahu, which is not included in the preceding thirty skeletons, exhibited a defect in the neural arch of the 5th lumbar, similar to that seen in the Bushman and Esquimaux. In one of the Negro skeletons the right half of the neural arch was normal, but the left lamina, with its inferior articular process, had remained distinct and separate from the spine, as well as from the pedicle of its own side. These five specimens show that the laminar part of the neural arch had arisen in them from a pair of ossific centres, quite distinct from the centres from which the pedicles took their origin; and that whilst the inferior articular processes belonged to the laminar part, the superior belonged to the peduncular part of the vertebra. As this condition was only seen in the 5th lumbar vertebra the question naturally arises, does the neural arch of this bone on each side normally develop from two ossific centres, laminar and pedicular, which subsequently fuse with each other, though in these five skeletons they had remained distinct; whilst in the other four lumbar vertebræ only a single pair of ossific centres are formed for the production of both the peduncular and laminar part of the arch. It is known, for instance, that the anterior division of the transverse process (parapophysis) in the 7th cervical vertebra is developed from a distinct centre, which may sometimes acquire the form and dimensions of a cervical rib, whilst the parapophysis in each of the other six cervical vertebræ arises by an extension into its cartilage of ossific material derived from the primary centres of ossification of the bone, so that this process in the cervical series does not develop uniformly in all the vertebræ. It is possible that the neural arch of the 5th lumbar vertebra may normally develop on a different plan from that of the other lumbars, so as to permit of such a separation of the laminar part of the arch as was found in these specimens. The development of the neural arch in this bone is worthy, therefore, of special investigation by the embryologist.

In the General Summary of the characters of the aboriginal Crania described in the First Part of this Report, I pointed out (p. 118) that a larger proportion of important variations from the usually described arrangements occurred in them than would have been found in a corresponding number of the skulls of the white races. With equal truth a similar remark may be made on the variations in the Spinal Column which I have just described. I am not able to state, numerically, the proportion in the white races in which variations in the form of the spinous processes of the cervical vertebræ, the occurrence of a supernumerary vertebra in the dorsi-lumbar region, or the development

of the laminar part of the neural arch independently of the pedicular part occurs, for observations on a sufficiently large number of specimens have not yet been systematically conducted. But this may without doubt be affirmed, that in a series of spinal columns from white races equal in number to those analysed in this chapter, and like them taken without selection, there would not have been found so large a proportion in which the 6th cervical spine was not bifid and nearly equal in length to the spine of the 7th cervical; or three skeletons with a supernumerary dorsal vertebra; or seven specimens of irregularity in the development of the neural arch of the 5th lumbar vertebra.

The Lumbar Curve of the Spinal Column.

In the course of the investigations into the characters of the skeletons described in this Report, I have measured the bodies of the lumbar vertebræ with the view of ascertaining if modifications existed in their vertical diameter, anteriorly and posteriorly, which might affect the lumbar curve of the spine.

Anatomists are in the habit of teaching that the human spine is convex forward in the lumbar region, so that a lumbar convexity is interposed between the thoracic and sacral concavities, and contributes to the alternating series of concavo-convex curves of the spinal column, which are associated with the erect attitude of man. My belief in the universality of the view that the lumbar vertebræ themselves invariably produce a forward convexity in that region was disturbed some years ago, when Charles Robertson, Esq., of the Oxford Museum, showed me the skeleton of an aboriginal Australian in that museum, which he had articulated in 1873. Mr. Robertson told me that the skeleton was that of an adult male of the Tomki tribe of the Richmond River, N.S.W. In it there was a continuous curve, concave forwards through both thoracic and lumbar regions. As the skeleton was, however, artificially articulated, the question naturally arose in one's mind if this modification in the lumbar curve might not have been produced by some peculiarity in the method of articulation, and was not therefore natural to the spine. Since I saw this skeleton, however, Mr. Robertson has written to tell me of another adult male from Port Augusta, South Australia, articulated in 1878 with great care and with especial attention to the lumbar curve, which exhibited a similar concavity in the lumbar region, and that the articulated skeletons of a Gilbert Islander and a male Andaman Islander have a similar lumbar concavity, though not so well marked. Before I had heard, however, of these later specimens in the Oxford Museum, I had examined the lumbar vertebræ in the series of spines at my disposal in Edinburgh, and had obtained some interesting results.

Two important factors contribute to the curve in the lumbar region, viz., the vertebral bodies and the intervertebral discs. The exact share contributed by each of these parts can only be ascertained with precision by applying to the vertebral column in the different races of men the method of observation which Professor D. J. Cunningham

of Trinity College, Dublin, has employed in the study of the spine in the Irish race, viz., the making of longitudinal mesial sections through the long axis of the spine in frozen bodies, and then carefully measuring the relative thickness both of the vertebral bodies and the discs. In the absence, however, of the fresh bodies of Australians and other Aborigines, I have been precluded from obtaining any information on the thickness of the discs, and have been restricted to the examination of the vertebræ themselves, so far as they have been preserved in the skeletons which have reached me. I have measured, therefore, the vertical diameter of the body of each lumbar vertebra, both in front and behind, and have noted the difference in each vertebra, and in the series of lumbar vertebræ in each spine.[1]

In order to obtain some data for comparison, I measured the lumbar vertebræ in twelve adult European spinal columns, the great majority of which were males, and found that the vertical diameter of the anterior surface of the bodies of the five vertebræ in each spine was collectively greater than the vertical diameter of the posterior surfaces in the same spine. The maximum difference between the collective depth of these surfaces in the series of five vertebræ was 11 mm. in one skeleton, and the minimum difference was 1 mm. in another skeleton. The mean collective depth of the five vertebral bodies in the twelve European skeletons was 137 mm. for the anterior, and 131·4 for the posterior surface, the mean difference therefore was 5·6 mm. in favour of the anterior surface. If we were to assume that in these spines each intervertebral disc had been of equal thickness throughout, then the greater thickness of the vertical diameter of the bodies in front than behind in each spine would have given a slight convexity forwards to the spinal column in the lumbar region. But we know that these differences in the vertical diameter in the lumbar region of Europeans are not limited to the vertebral bodies, and that some of the discs also are thicker anteriorly than posteriorly, so that the anterior convexity would therefore by their interposition be increased.

In the individual lumbar vertebræ in each of these European spinal columns, with only two exceptions, the body of the 1st lumbar vertebra was deeper behind than in front, in one instance 6 mm., in another 4 mm., but usually not more than 1 or 2 mm.; in the exceptional cases the anterior and posterior vertical diameters were equal. The body of the 2nd lumbar was deeper behind than in front in six spines; they were equal in depth in four spines, and the anterior surface was deeper than the posterior in two spines. The body of the 3rd lumbar was deeper in front than behind in ten spines, and in two they were equal. The body of the 4th lumbar was deeper in front than behind in eleven spines, and deeper behind than in front in one specimen. The body of the 5th lumbar was deeper in front than behind in all the specimens. From these spinal columns it is

[1] When my paper on the lumbar curve was published in the *Journal of Anatomy and Physiology*, April, 1886, vol. xx., I was not aware that Dr. Cunningham had given an abstract of his researches in *Nature*, 18th February of the same year. He has since kindly directed my attention to this abstract, and I have now incorporated in this Report many of the facts contained in it.

evident that, whilst in the 1st and 2nd lumbar vertebræ the body was deeper behind than in front in a considerable proportion of the specimens, in the 3rd and 4th lumbar the reverse occurred, until in the 5th lumbar the bodies of all the specimens had a greater vertical diameter anteriorly than posteriorly, and this indeed is a character of the 5th lumbar that has long been recognised by the descriptive human anatomist. The vertical diameter of the body of the 4th lumbar in the twelve skeletons amounted to 336 mm. for the anterior surfaces collectively, and to 313 mm. for the posterior surfaces collectively. In the 5th lumbar the vertical diameter of the anterior surfaces collectively amounted to 337 mm., and the posterior surfaces to 281 mm.; the mean anterior depth was 28 mm., the mean posterior 23·4, and the mean difference in favour of the anterior surface was 4·6 mm. Hence it follows that of all the lumbar vertebræ the 5th had much the greater proportional depth at the front as compared with the back of its body, and that it contributed more than any of the others to the anterior convexity of the lumbar region, so far as that is produced by the bodies of these vertebræ.

For the purposes of comparison of the lumbar region in Europeans with the same region in the spines of other races of men, it may be well to frame a general lumbar index for the entire region, and a special index for the body of each vertebra. If we assume the vertical diameter of the bodies of the five vertebræ anteriorly to be = 100, then the formula $\frac{\text{posterior diameter} \times 100}{\text{the anterior diameter}}$ would give the *general lumbar index*, and by a similar formula the *special index* of each vertebra may be obtained.

In Table X. the mean index of each lumbar vertebra in the series of twelve European spines is given, from which it will be seen that the index diminished from 106·8, that of the 1st lumbar vertebra, to 83·6, that of the 5th. The mean general index of the series of five lumbar vertebræ was 96. Dr. Cunningham in the abstract of his researches on

TABLE X.—LUMBAR INDICES.

Mean special Index of	12 Europeans.	5 Australians (4 ♀, 1 ♂).	2 Andaman Islanders.	3 Negros (2 ♀, 1 ♀).	3 Oahuans, Sandwich Islands.
1st Lumbar vertebra, . .	106·8	114·4	111·3	108·8	114·6
2nd „ „ . .	101·5	112·3	105·6	104·2	108·0
3rd „ „ . .	95·4	108·0	102·0	100·0	108·2
4th „ „ . .	93·0	103·7	91·8	93·0	101·5
5th „ „ . .	83·6	91·4	84·2	89·0	87·7
Mean general Lumbar Index, .	96·0	105·96 = 106·0	98·98 = 99·0	99·0	104·0

the lumbar curve which he has recently published has given the mean lumbar indices in seventy-six European skeletons, the general results of which accord very closely with those which I have obtained from my more limited number of skeletons. The mean index in his series was 95·8, and the mean index of the individual vertebræ ranged from 106·1 for the 1st lumbar to 81·6 for the 5th. He also pointed out that the two sexes differed in the proportional depth of the anterior and posterior surfaces of the bodies of the lumbar vertebræ, so that they did not have the same mean lumbar index. The average in twenty-one Irish men he found to be 96·2, and in twenty-three Irish women 93·5, from which it is evident that in the women the anterior vertical diameter of the five lumbar bodies collectively was proportionally greater than in the men, and the lumbar spine in them was more convex.

During the past few years I have collected the skeletons of seven adult aboriginal Australians—six men and one woman. In four of the men the lumbar spine is complete, in one the last lumbar vertebra has been lost, in another the 3rd, 4th and 5th lumbars are absent; in the woman all the lumbars are present. In each of the five skeletons in which the lumbar spine was complete, the vertical diameter of the bodies of the five vertebræ collectively was deeper behind than in front; the maximum difference observed in three male skeletons was 9 mm., the minimum in the woman was 2 mm. The mean collective depth of the five vertebræ in the five perfect Australian skeletons was 112·2 mm. for the anterior surface of the bodies, and 118·8 mm. for the posterior surface; the mean difference, therefore, was 6·6 mm. in favour of the posterior surface. In the skeleton in which the 5th lumbar was absent the collective diameter of the four lumbars was 3 mm. greater behind than in front. In the relation of the vertical diameter of the posterior surface to the anterior surface the opposite condition prevailed to that which was found in the Europeans. Before, indeed, I had measured the vertebræ in these Australians, I found that, when the bodies of the lumbar vertebræ in each spine were placed in apposition with each other, without the interposition of artificial discs, they produced a concave curve forward, and not a convex curve as in the European spine, so that I was not surprised to see, when the bodies were measured, that collectively they were deeper posteriorly than anteriorly.

When the measurements of the individual lumbar vertebræ in the series of Australian spines were compared, it was seen that the body of the 1st lumbar vertebra in every instance was deeper behind than in front, in four skeletons as much as 4 mm. The body of the 2nd lumbar was with one exception deeper behind than in front, in two specimens as much as 4 mm.; in the exceptional vertebra the depth in front was 1 mm. greater than behind. The body of the 3rd lumbar in four skeletons was deeper behind than in front; in one skeleton they were equal, and in another—the adult female—the anterior diameter was 1 mm. deeper than the posterior. The body of the 4th lumbar* was deeper behind than in front in three skeletons; these diameters were equal in one,

and in two the anterior diameter was greater than the posterior. The body of the 5th lumbar was deeper in front than behind in all the five complete skeletons, the maximum difference between the two surfaces being 3 mm.

When these dimensions are compared with those obtained from the European spinal columns, it will be seen that in the 1st, 2nd, and 3rd lumbars the body was more constantly deeper behind than in front in the Australians than in the Europeans. In the 4th lumbar, whilst it was the exception in the Europeans for the body to be deeper behind than in front, in the Australians one-half the skeletons exhibited this relation. In all the Australians, as in the Europeans, the body of the 5th lumbar was deeper in front than behind; the mean vertical diameter of the anterior surfaces was 23·2, and of the posterior 21·2, a difference of 2 mm. only in favour of the anterior surface; whilst in the Europeans the anterior surface was on the average 4·6 mm. thicker than the posterior.

In Table X. the mean index of the five Australian skeletons in which the lumbar spine was complete is given. The mean index of the separate vertebræ diminished from 114·4 in the 1st lumbar to 91·4 in the 5th, and the mean general index of the entire series was 106. Dr. Cunningham has stated in his abstract the mean lumbar indices in seventeen Australian spines, and obtained from them a mean index 107·8, which was somewhat higher than in my measurements. The range in his series was from 119·8, the mean index of the 1st lumbar, to 90·4, the mean index of the 5th. In his series six males had a mean lumbar index of 110·1, and four females of 103·1.

In my single male Bush skeleton the collective vertical diameter of the bodies of the five lumbar vertebræ was 108 mm. anteriorly, and 115 mm. posteriorly. In the 1st, 2nd, and 3rd lumbars the posterior diameter exceeded the anterior; in the 4th these two diameters were equal, and in the 5th the anterior diameter was 1 mm. greater than the posterior. The proportions in this skeleton closely corresponded to what was seen in the Australians. The general lumbar index was 106, and the index of the 5th lumbar vertebra was 95. Dr. Cunningham has given 106·6 as the mean lumbar index of three Bushmen, whilst the mean index of the individual vertebræ ranged from 115·9 in the 1st lumbar to 95·3 in the 5th.

In my series of Andaman Islanders' skeletons only two had the lumbar vertebræ complete. In one the vertical diameter of the five vertebræ collectively was 113 mm. anteriorly, and 112 mm. posteriorly; in the other 125 mm. anteriorly, 124 mm. posteriorly. The 1st and 2nd lumbars in both skeletons were thicker behind than in front. The 3rd lumbar in one skeleton was of equal diameter on both aspects, and in the other was 1 mm. thicker behind than in front. In both skeletons both the 4th and 5th lumbars were thicker in front than behind, in the one skeleton the anterior surface of the 5th lumbar being 3 mm., in the other 5 mm., thicker than the posterior. The mean index in the two skeletons diminished from 111·3 for the 1st lumbar to 84·2 for the 5th (Table X.); the mean general lumbar index of the two skeletons was 99. Dr. Cunningham

has given the mean lumbar index of the twenty-three Andaman Islanders, which he has measured as 104·8, which was considerably higher than the average of my two specimens. Fourteen of his skeletons were males with a mean lumbar index 106·3, and nine were females with a mean lumbar index 102·4.

In three Negro skeletons I was able to measure the vertical diameter of the bodies of the lumbar vertebræ both in front and behind. In each of the three skeletons the collective vertical diameter of the five lumbar bodies was slightly greater in front than behind; the maximum difference, however, was only 2 mm. The mean collective depth of the five vertebræ in the three Negro skeletons was 121 mm. for the anterior surfaces, and 119·6 mm. for the posterior surfaces; the mean difference, therefore, was 1·4 mm. in favour of the anterior surface. In all three skeletons, both the 1st and 2nd lumbars were slightly deeper behind than in front; the 3rd lumbar was equal in depth both anteriorly and posteriorly, whilst both the 4th and 5th lumbars were somewhat deeper in front than behind. The mean index in the three skeletons diminished from 108·8 in the 1st lumbar to 89 for the 5th, and the mean general lumbar index of the five vertebræ was 99. Dr. Cunningham obtained from the measurements of ten Negros a mean lumbar index of 105·4; his series of skeletons consisted of seven males with an index of 106, and three females of 103·4; whilst my skeletons were two females and one male, which may perhaps in some measure account for the mean general lumbar index being lower in my specimens than in his.

In a Maori skeleton, from Otago, the vertical diameter of the series of five vertebræ was the same both in front and behind, viz., 101 mm. The 1st and 2nd lumbars were slightly deeper behind than in front, the 3rd and 4th were equal in depth on both surfaces, and the 5th was 3 mm. deeper in front than behind. The general lumbar index was 100, and the index of the 5th lumbar vertebra was 85.

In each of two female skeletons from Oahu, in the Sandwich Islands, and in the spine of a third skeleton, apparently a male, the collective vertical diameter of the five lumbar bodies was greater behind than in front; in one skeleton the difference was 7 mm., in another 4 mm., in the third 3 mm., in favour of the posterior surface. The mean collective depth of the five vertebræ in the three skeletons was 121·6 mm. for the anterior, and 126·3 mm. for the posterior surfaces; the mean difference, therefore, was 4·7 mm. in favour of the posterior surface. In both female skeletons the bodies of the 1st, 2nd, 3rd, and 4th lumbars were all deeper behind than in front, whilst the 5th lumbar was deeper in front than behind. In the male the 1st, 2nd, and 3rd were deeper behind than in front, but the 4th and 5th were deeper in front than behind. The mean index in the three skeletons diminished from 114·6 in the 1st lumbar to 87·7 in the 5th. The mean general lumbar index of the five vertebræ was 104.

Dr. Cunningham has stated the mean lumbar index of three Tasmanian skeletons to be 107·2; two of these were males and their mean index was 108·5, whilst the lumbar

index in the female was 104·7. The mean index of the individual vertebræ ranged from 115·1 in the 1st lumbar to 92·4 in the 5th.

In one of three Hindoo skeletons, the tall male presented by Dr. John Anderson, the vertical diameter of the series of five lumbar bodies was 137 mm. anteriorly, and 146 mm. posteriorly. The 1st, 2nd, and 5th lumbars were deeper behind than in front, the 3rd was 1 mm. deeper in front than behind, and in the 4th these two diameters were equal. The general lumbar index was 106, and the index of the 4th lumbar vertebra was 107. In the two other Hindoo skeletons, a male and a female, the vertical diameter of the bodies of the five lumbars was somewhat deeper in front than behind, and the mean lumbar index was 97·3. In each of these skeletons the vertical diameter of the 5th lumbar vertebra was deeper in front than behind, and the mean index was 89. In the skeleton of a male Sikh, the vertical diameter of the five lumbar bodies was 130 mm. anteriorly and 133 mm. posteriorly, being a difference of 3 mm. in favour of the posterior diameter. In this skeleton the 1st and 5th lumbar bodies were deeper behind than in front, but the 2nd, 3rd, and 4th were each of equal diameter on both aspects. The lumbar index was 102, and the index of the 5th lumbar vertebra was 108·7.

In a Chinese skeleton the vertical diameter of the five lumbar bodies was 145 mm. anteriorly, and 123 mm. posteriorly. In each vertebra, except the 1st, the vertical diameter was deeper in front than behind, and in the 1st the two diameters were equal. The general lumbar index was 84·8, and the index of the 5th lumbar vertebra was 70. In a male Malay skeleton, the vertical diameter of the five lumbar bodies was 127 mm. anteriorly, and 125 mm. posteriorly. In the 1st, 2nd, and 3rd the posterior diameter was deeper than the anterior; in the 4th and 5th the anterior diameter was deeper than the posterior. The general lumbar index was 98, and the index of the 5th lumbar vertebra was 77·7.

In a female Esquimaux the vertical diameter of the series of five lumbar bodies was the same in front and behind (127 mm.), so that the general lumbar index was 100. In a male skeleton the vertical diameter of the bodies anteriorly was 120 mm., and posteriorly 116 mm., and the general lumbar index was 96·6. Both in the female and male the 1st and 2nd lumbars were deeper behind than in front, but the 4th and 5th lumbars were deeper in front than behind. The index of the 5th lumbar vertebra in the female was 81, and in the male 71. In a male Laplander the vertical diameter of the five lumbar vertebræ was 111 mm. anteriorly and 110 mm. posteriorly, and the general lumbar index was 99. In a female Laplander the vertical diameter was anteriorly 121 mm., and posteriorly 118 mm. and the general lumbar index was 97·5. In both skeletons, whilst the 1st lumbar vertebra was deeper behind than in front, both the 4th and 5th lumbar were deeper in front than behind. The index of the 5th lumbar in the male was 86, and in the female 88.

From the observations which have been made both by Dr. Cunningham and myself,

working quite independently of each other, and on two distinct series of skeletons of various races of men, it is obvious that differences exist amongst them in the relative thickness of the bodies of the lumbar vertebræ anteriorly and posteriorly. The production of bone in the bodies of the lumbar vertebræ of these races has been so adjusted that they are collectively thicker in front than behind in the white races, and behind than in front in the black races. If the spinal column consisted only of the osseous vertebræ in direct articulation with each other, both by their articular processes and bodies, the lumbar region would then be concave forward in the black races, and convex forward in the white races. But the spine, in addition to the osseous vertebræ, contains an intercalated series of intervertebral elastic discs, and these discs may perhaps be so adjusted in the black races as to be collectively thicker in front than behind in the lumbar region, and thus to compensate for the want of development in depth of the anterior surface of the vertebral bodies, and to give to the column a forward convexity in that region as in the white races, although not perhaps in so well-marked a degree. Should this be the case, it would follow that in the course of the development and ossification of the spinal column in the lumbar region in these races, important differences would arise anteriorly and posteriorly in the proportion of that mesoblast tissue which becomes cartilage and bone, and that which becomes intervertebral disc. We have no information, however, on the thickness of the discs in the black races, either relatively or absolutely, so that this interesting question is not in a position to be definitely answered.

Putting on one side, therefore, for the present, the question of modifications in the relative thickness of the discs, and limiting ourselves to the consideration of the influence which the bodies of the vertebræ themselves would have on the curvature of the spine, we find a very considerable range of variation in the vertical diameter anteriorly and posteriorly of the series of five lumbar vertebræ. These differences are expressed numerically by the general lumbar index. In my series of skeletons the lowest index was in a Chinese, 84·8, and the highest both in a Bushman and in a male Hindoo, 106, but Dr. Cunningham has obtained, as the mean of two male Tasmanians, an index as high as 108·5, and of ten male Australians, 110·1. Without at present taking into consideration the compensatory arrangements in the living body which might modify these relative differences in thickness, the lumbar spine—so far as represented by the bodies of its vertebræ, and with the lower surface of the body of one vertebra in contact with the upper surface of the body of the vertebra next below—might present one or other of three forms in different races of men. It might be convex forwards, or straight, or concave forwards, and to each group an arbitrary numerical limit might be assigned, based on the general lumbar index. We might assume that such a series of vertebræ, with the general lumbar index calculated only from the vertical diameters of the lumbar bodies, and ranging from 98 to 102, both inclusive, formed a straight spine, *Orthorachic* (ὀρθός, straight, ῥάχις, spine); one with a general index

above 102 had the lumbar curve concave forwards, *Koilorachic* (κοῖλος, hollow); one with a general lumbar index below 98 had the curve convex forwards, *Kurtorachic* (κυρτὸς, arched, convex).

The data now before us are sufficiently large to enable one to state with certainty that the lumbar vertebræ in Europeans are collectively convex forwards, since the mean general lumbar index is between 93 and 96; and from the low index in my single Chinese skeleton it is probable that the mean of this race may also be very distinctly kurtorachic.

On the other hand, in the Australians, the mean general lumbar index is in my series 106·0, and in that of Cunningham 107·8; so that the vertebræ are collectively deeper behind than in front, and there can, I think, be little doubt that the two Australian skeletons in the Oxford Museum articulated by Mr. Charles Robertson will, when measured, also show a corresponding relation in the vertical diameter of the lumbar bodies. A similar arrangement prevails in the Bush race in which the mean general lumbar index of four skeletons, measured by Cunningham and myself; was 106·0. From the measurements of my three Oahuans, yielding a mean index of 104, it is probable that the Sandwich Islanders are also koilorachic, and the same would apply to Cunningham's Tasmanians.

The limited series of Negro and Andaman skeletons at my disposal gave a mean index in each case of 99, which would have placed them in the orthorachic category, but the more numerous measurements of Cunningham have shown that they possess a higher mean lumbar index, which he states to be 105·4 for the Negros, and 104·8 for the Andaman Islanders, so that both these races are, without doubt, koilorachic. My single Maori, with an index 100, possibly also the Hindoos, Sikh, Laplanders, and Esquimaux, may be orthorachic, but the specimens are too few in number to enable one to state with certainty the mean general lumbar index in these races.

As regards the 5th lumbar vertebra, in all the skeletons which I have measured, with two exceptions, the vertical diameter of the anterior surface of the body was greater than that of the posterior. There are, without doubt, differences in the relative depth. The anterior diameter was proportionally greater than the posterior in the Chinese, Malay, Esquimaux, Lapps, Europeans, and Andaman Islanders, than was the case in the Australians, Bush, Negros, and Hindoos. But in a single Hindoo skeleton, and in the Sikh, the posterior diameter of this vertebra was greater than the anterior; these, however, were probably individual exceptions, and this greater depth would assist in giving the high lumbar index to these two skeletons.

In order, in the absence of the discs, to put the lumbar vertebræ approximately into the position which they might have had when the discs were in position, I then had the vertebræ articulated with each other in several of those spines in which the posterior vertical diameter of the bodies markedly exceeded the anterior. In making this articulation the upper border of the superior articular facet of the vertebra below

was placed in the same transverse plane as the upper border of the inferior articular facet of the vertebra above. The gaps left between the vertebral bodies probably approximated therefore to the size and form of the intervertebral discs, and the lumbar curve which was produced bore, without doubt, a relation to the curve in the living person. In the Bush spine (fig. 3) the anterior concavity of the dorsal region was continued down to as far as the lower border of the body of the 4th lumbar and the interval between it and the 5th, which, along with the upper border of the body of the 5th lumbar, were the

Fig. 3.

Fig. 4.

FIG. 3.—Profile view of lumbar spine of Bushman articulated as described in text. The neural arch as formed by the laminæ and spinous process of the 5th lumbar was separate from the pedicles, and is not represented in the figure. *v*, vertical line.

FIG. 4.—Profile view of lumbar vertebræ of a male Australian from Perth, Western Australia. Both these figures are from photographs.

most projecting parts of this region. The body of the 5th lumbar vertebra was directed downwards and backwards from this most anterior projection. The interval for the disc between the 4th and 5th lumbar bodies had a very definite wedge-shaped form, with the narrow end of the wedge directed backwards.

In the Perth Australian (fig. 4) the lumbar spine above the lower border of the 4th vertebra was faintly concave forwards, but not to so great an extent as in the

Bushman, and the anterior part of the 5th vertebra was almost in the same vertical plane as the lower border of the 4th. The interval between the bodies of these two bones was not so strongly wedge-shaped as in the Bush skeleton. In the Eucla, Manly Cove, and West Victoria skeletons, the lower border of the body of the 4th lumbar was also the most prominent point in the lumbar region, and the body of the 5th lumbar inclined backwards and downwards from this point. But in these three skeletons the anterior convexity showed itself at the body of the 3rd lumbar vertebra. This was apparently also the case in the Queensland Australian, but the defect in the development of the body of the 5th lumbar described on p. 63, and some osseous outgrowths from the sides of the bodies of the other lumbar vertebræ, gave a twist to this part of the column which interfered with accurate observation.

In one of the Oahuan skeletons the most prominent point in the lumbar region was either the lower border of the body of the 4th lumbar or the upper border of the body of the 5th lumbar, and from the dorsal region downwards to this point the curve of the spine was concave forwards, whilst the body of the 5th lumbar sloped downwards and backwards from it. In another Sandwich Islander the form was somewhat modified, owing to the body of the 2nd lumbar projecting somewhat in front of both the 1st and the 3rd lumbars.

Variations in the anterior curvature of the spine in the lumbar region would in all probability affect the outline of the back of the body in that region, as one would expect the loins to have a deeper hollow when the spine possessed a strong anterior convexity, than when it did not have a well-marked lumbar curve. Luschka had, indeed, some years ago pointed out[1] that a strong concavity in the loins was a character of the body of a well-formed woman, in whom, as has already been stated, the lumbar spine is more convex forwards than in men. How far these departures in the lower races of men from the proportions of the front and back of the vertebral bodies, as seen in the higher races, may serve to modify the curvature of the lumbar spine in the erect attitude can only be definitely settled when the intervertebral discs, as well as the vertebral bodies, have been measured, and when the influence exercised by the discs on the production of the anterior lumbar convexity has been accurately determined.

The upper and lower surfaces of the body of a lumbar vertebra are parallel to each other only in those bones in which the vertical diameters anteriorly and posteriorly are equal, but as this is the exception and not the rule, it follows that in the lumbar spine it is customary for these surfaces not to be parallel, but to approximate in their antero-posterior diameter to the form of a wedge. My observations show that the surfaces of the body are either parallel, or approach most closely to it, either in the 2nd or 3rd lumbar, whilst they diverge most widely from it in the 1st and 5th lumbar. Aeby, in his examination of the European spine, found[2] the 2nd lumbar to be the vertebra in

[1] Die Anatomie des Menschen, Bd. ii. p. 80, 1863.

[2] *Archiv für Anatomie*, p. 91, 1879.

which the vertical diameters in front and behind were usually equal, whilst the 1st lumbar had the anterior diameter 0·4 mm. less than the posterior, and the 5th lumbar had the anterior diameter 6·2 mm. greater than the posterior. Aeby regards, therefore, the change from the concavity of the thoracic part of the spine to the convexity of the lumbar to take place at a point between the 2nd and 3rd vertebræ, which opinion is substantially corroborated by my observations. It is, therefore, at the two ends of the lumbar series of vertebræ that the wedge-shaped form of the bodies is most distinct, the 4th and 5th vertebræ having the narrower part of the wedge directed backwards to the spinal canal, whilst in the 1st it is directed forwards to the front of the spine. This statement applies to the individual vertebræ, both in the black and white races; but, as in the Australians, for example, the upper three lumbars were more constantly deeper behind than in front, and the lower two lumbars were proportionally less thick in front than behind than in Europeans, the general effect was to produce, so far as the depth of the vertebral bodies themselves and without the intermediate discs can influence the curvature, a lumbar spine, in the one race concave forwards, and in the other convex forwards.

The question now arises, at what period of life do the bodies of the lumbar vertebræ assume the wedge-shaped form? From the measurements, both of Aeby[1] and Ravenel,[2] it would appear that in the new-born child neither the vertebral bodies nor the discs are wedge-shaped, and that in all the regions of the spine the anterior and posterior vertical diameters are equal, so that the spine, the sacral region being excepted, is almost straight. In a boy of three months, measured by Ravenel,[3] the lumbar region, including apparently both bodies and discs, was 6 mm. higher anteriorly than posteriorly, and in one of two years 1 cm. higher. In the spine of a child, apparently in its second year, measured by myself, the bodies of the lumbar vertebræ were collectively 4 mm. thicker in front than behind, and the half of the increase was in the body of the 5th lumbar. It is obvious, therefore, that the anterior vertical diameter of the lumbar region increases with the assumption of the erect posture, and with the formation of the convex forward curve in the lumbar spine. Some years ago Ravenel measured in Bern the spine in twenty-two adult Europeans, eleven of either sex. The mean proportions of the lumbar part of the column—the anterior surface of the entire column being estimated as = 100—was in men 30·5 for the anterior surface of the lumbar spine, and 26·4 for the posterior surface; whilst in women it was 31·9 for the anterior, and only 22·2 for the posterior surface. The difference, therefore, for the two sexes was 4·1 in favour of the anterior surface in the men, and 9·7 in the women, so that the lumbar spine was considerably more convex in the latter sex. Ravenel also stated that in women the posterior surface of the whole spinal column was 6 per cent. shorter than in men, which, for the most part,

[1] Der Bau des menschlichen Körpers, Leipzig, 1871, p. 159. Die Altersverschiedenheiten der menschlichen Wirbelsäule, *Archiv für Anatomie*, p. 77, 1879.

[2] Die Massverhältnisse der Wirbelsäule, *Zeitschr. für Anat. und Entwicklungsgeschichte*, Bd. ii., 1877.

[3] *Op. cit.*

was due to the diminished proportion in the lumbar region. The observations of the brothers Weber,[1] made many years ago on a European skeleton, gave to the series of anterior surfaces of the bodies of the five lumbar vertebræ a height of 6·7 mm. above the posterior surfaces, with which my measurements closely approximate; whilst the height of the anterior surfaces of the discs (including those from the 12th dorsal to the 5th lumbar vertebræ) was 11·9 mm. above the posterior, but if the disc between the 5th lumbar and 1st sacral be also taken into account, then the anterior surface of the collective series of discs was 21·1 mm. more than the posterior, so that the discs contributed about three times more to the anterior convexity than did the bodies. There can, indeed, be no doubt that it is the rule in the adult European spine for the disc between the 5th lumbar and the 1st sacral vertebra to be very materially thicker in front than behind. The existence of an anterior convexity in the lumbar spine shows that the growth proceeds more rapidly in front than behind, and in this growth, both the vertebral bodies collectively and the discs participate in the European spine.

If we were to assume that in the black races the lumbar spine possessed a forward convexity equal to the average convexity of Europeans, it would then be necessary, owing to the diminished depth of the anterior surfaces of the vertebral bodies as compared with the posterior, for the discs to be very much thicker in front than behind, either throughout the lumbar region or in a part of its extent, so as to throw the bodies forward. Were this the case then in the lumbar spine the elastic discs would make up an even larger proportion of this region of the column than in the white races, and their growth would necessarily have been much more active in front than behind. The brothers Weber pointed out long ago that whilst the form of the articular processes of the lumbar vertebræ interfered with lateral flexion and rotation in this region, yet that the lumbar spine had great flexibility from before backwards through the interposition of these elastic discs. But even should the lumbar region be less convex forwards in the black races than in the Europeans, it is not unlikely that the proportion of elastic disc to inelastic bone may be greater in the former than in the latter; greater flexibility would thus be given to the spine, and the body would more easily be enabled to assume those positions during rest and in motion which have been already referred to in the section on the age characters of the pelvis, as more frequently adopted by man in his wild and native state than when living under the influences of civilisation.

[1] Mechanik der menschlichen Gehwerkzeuge, pl. viii. p. 92, Göttingen, 1836.

STERNUM.

The sternum was present in thirty of the skeletons. As a rule the præ- meso- and xiphi-sternal segments were not united to each other, and the xiphi-sternum had usually been lost. In the following specimens this rule was departed from. In the Perth Australian and the Sikh, the præ- was fused with the meso-sternum, but the xiphi-sternum was free. In an Andaman Islander and the Malay the xiphi-sternum was ossified and fused with the meso-sternum, but the manubrium was free. In an Andaman Islander, in which the epiphyses of the long bones were not fully ossified to the shafts, the præ-sternum was fused with the first segment of the meso-sternum, but the latter was not ankylosed to the second segment, and in the lowest segment of this division of the bone the two lateral halves were imperfectly united mesially. In the Chinese the first segment of the meso-sternum was free, but the second, third, and fourth segments were fused together, and the xiphoid was ossified but not fused with the meso-sternum; this skeleton, from the ossification of the long bones, apparently belonged to a man from twenty to twenty-four years of age. In the Manly Cove Australian, although all the segments of the mesosternum were ankylosed together, yet a distinct fissure marked the plane of fusion of the first and second segments.

In the Bush skeleton, the Malay and the male Lapp, the meso-sternum was perforated by a hole, large enough to admit a quill, situated at the junction of its third and fourth segments; in the Malay the first pair of costal cartilages were ossified on the surface. A meso-sternal hole due to defect in the ossification of the cartilaginous sternum is sometimes seen in Europeans.

These sterna do not throw much light on the question whether the manubrium or the xiphi-sternum unites first with the meso-sternum, for whilst there are two cases of fusion of the xiphi-sternum, without ankylosis of the manubrium, there are also two cases of fusion of the manubrium without ankylosis of the xiphi-sternum. There is also one remarkable instance of fusion of the manubrium with the first segment of the meso-sternum before the meso-sternum itself had completed its ossification, but this is quite exceptional. It is without doubt the rule for the manubrium not to fuse with the meso-sternum until comparatively late in life. The Malay skeleton and one of the Oahuan women show that ossification of the costal cartilages may have considerably advanced without the præ- and meso-sternum having become ankylosed together. The condition of ossification of the sternum does not, I think, afford any accurate guide to the age of the skeleton, and in this respect my observations conform with those of Dr. Thomas Dwight.[1]

[1] The Sternum as an index of Sex and Age, *Journ. Anat. and Phys.*, vol. xv. p. 327, 1881.

CLAVICLE.

In the series of skeletons the clavicle presented various modifications in length, thickness, degree of curvature, and prominence of the ridges and processes for attachment of muscles and ligaments. These modifications were apparently in great measure to be associated with sex, and with the degree of muscular development. It was especially observed, in the majority of the bones, that the groove on the under surface for the subclavius muscle was either absent or very faintly marked.

Measurements of the Clavicle.

I took the length of the clavicles in each skeleton, with the view of ascertaining their absolute length, if differences existed between the bones on opposite sides of the same skeleton, and the proportionate length of the clavicle to the humerus.

The length of the clavicle was measured in a straight line between the sternal and acromial ends of the bone; 150 mm. may be taken as expressing the mean length of the clavicle in the men of the British Islands, and 140 mm. the mean length in the women.

The maximum clavicle in my series of male Australians was 160 mm. in the Riverina skeleton, the minimum 121 mm. in the Perth skeleton, and the mean 142·2 mm. The contrast in shape between the elongated, curved clavicle of the man from the Riverina and the short thick clavicle of the Perth Australian was very marked. In the female Australian the length was 118 mm. The Bush clavicles, notwithstanding the diminutive stature, were each 147 mm. long, and were slender curved bones. Six Oahuan clavicles varied from 117 mm. to 153 mm., and the mean was 139 mm. The clavicle in the Andaman Islanders ranged from 112 to 126 mm., and the mean was 119·3 mm.; the bones were not strongly curved and were slight. In two Negresses the maximum clavicle was 150 mm. and the minimum 134, whilst the mean was 141·7 mm.; in three Negros the longest was 160 mm., and the shortest 140, the mean being 149·4 mm. In the Otago skeleton the clavicle was 134 mm. In the three Hindoos the clavicle ranged from 118 mm. in the women to 165 mm. in the tall male. In the Sikh the longer clavicle was 164 mm., in the Malay 158 mm., and in the Chinese 132 mm. In the female Lapp the longer bone was 122 mm., and in the male 148 mm. In the female Esquimaux the longer clavicle was 147 mm., and in the male 142 mm.

In eight skeletons the right clavicle was longer than the left, in the Malay skeleton by as much as 6 mm. In fifteen skeletons the left clavicle was longer than the right; in an Andaman Islander and the female Esquimaux by 6 mm., and in the Riverina Australian by 7 mm. In Dr. Anderson's tall Hindoo the left clavicle was 18 mm. longer

than the right, but the difference was so great that I am led to think the shorter bone probably did not belong to this skeleton.

Many years ago the late M. Paul Broca[1] compared the length of the clavicle with that of the humerus in the same race, and came to the conclusion that in the Negro this bone was, like the radius, longer in proportion to the humerus than in the European. If the humerus be regarded as = 100 then he found that the clavicle in five European men had the proportion 44·3, and in four European women 45·0, whilst in nine Negros it was 45·8, and in seven Negresses 47·4.

The mean length of the clavicle in my six male Australians, as I have just stated, was 142·2, and the mean length of the humeri, in the same skeletons, was 335·7, and the proportion of the clavicle to the humerus, which may be termed the *clavículo-humeral index*, was 42·3 to 100, which is less than M. Broca obtained in male Europeans. In my Bushman's skeleton, owing to the length of the clavicle, the clavículo-humeral index was 51·4, whilst in the so-called Hottentot Venus, a female of the Bush race, this index, from Broca's measurements, was only 42. The mean length of the humeri in my three Negros was 341·8, and that of the clavicles 149·4, so that the clavículo-humeral index was 43·7, which is below the mean obtained by Broca both for his Negros and Europeans; the mean length of the humeri in my two Negresses was 314·5, and that of the clavicles 141·7, the clavículo-humeral index was 45, which is almost the same as the mean in the European women as obtained by Broca, but considerably below the mean of his seven Negresses. M. Broca also gives the proportion of the length of the clavicle in an Esquimaux skeleton as 43·8. In my male Esquimaux skeleton the clavículo-humeral index was 41·5, and in my female 44·6.

It seems doubtful if the relation between the length of the clavicle and the humerus is sufficiently definite to permit it to be employed with certainty as a race character. At any rate it is obvious that a much larger number of skeletons than I have before me, or the clavículo-humeral proportions of which have yet been recorded by anatomists, would require to be measured before the mean ratio of the clavicle to the humerus for each race can be obtained.

[1] Sur les proportions relatives du Bras, de l'Avant-bras et de la Clavicule chez les Nègres et les Européens, *Bull. de la Soc. d'Anthropologie*, April 3, 1862, t. iii. p. 162, 1862. Observations by M. Emile Pasteau in a Thesis entitled Recherches sur les proportions de la Clavicule dans les Sexes et dans les Races, Paris, 1879, a notice of which is in the *Revue d'Anthropologie*, p. 150, 1881, would seem to give support to Broca's conclusions regarding the relative lengths of the clavicle and the humerus in Negros and Europeans, but as regards other races no positive result was apparently obtained.

SCAPULA.

The scapulæ belonging to the skeletons from which the pelves were obtained, were examined with reference to their form and proportions. In all, twenty-nine pairs were under observation, and with the exception of the male and female Laplanders they were not the scapulæ of Europeans.

In the Australians the scapulæ were as a rule smaller than in Europeans of the same sex; the axillary border was somewhat more concave, and the borders of the infraspinous fossa sloped more rapidly to the inferior angle. The suprascapular notch was distinct in each bone, although in the Riverina and Perth skeletons it was shallow. Both the acromion process and spine were well developed. The small size of the scapulæ in the Bush skeleton conformed with the diminutive stature of the race. In the right bone the suprascapular notch was present, though shallow, but in the left bone, in which the supraspinous fossa was deep anteriorly, the notch was converted into a foramen by a broad plate of bone. The right acromion and spine were present, but on the left side they were absent, either through non-development or removal early in life.

In four of the Negro skeletons the suprascapular notch was distinct, and in one of these especially so; but in a fifth skeleton the superior border of each scapula was deeply falciform, and the suprascapular notch was not differentiated.

In the Andaman Islanders the scapulæ were small, slender, and with the muscular impressions not strongly pronounced. In three skeletons a shallow suprascapular notch had been differentiated at the root of the coracoid, but in the fourth the superior border of the scapula was falciform and the notch was not specialised. This latter character of the scapula in these islanders was observed by Prof. Flower, who states that in only three of the large series which he examined was a distinct notch present, and that, especially in the females, the superior border was deeply excavated.

In the Maori from Otago the axillary border was falciform, owing to a broad process projecting forwards from it at the anterior limit of attachment of the teres major; the infraspinous region therefore presented considerable breadth near the inferior angle, and the plate-like character of the bone was increased. The superior border of the right scapula formed a continuous concavity, and was without a suprascapular notch; but in the left bone an oblique foramen pierced the supraspinous fossa close to the base of the coracoid, and had without doubt transmitted the suprascapular nerve; the notch therefore in this bone was crossed by an osseous bridge. The scapulæ of the Sandwich Island women from Oahu were thin and light; in the one the suprascapular notch was shallow, in the other it was of ordinary depth.

In the female Hindoo the scapulæ were slender, and in them and those of the smaller male the suprascapular notch was shallow; but in the tall male these bones were much

more massive, and in the left scapula the notch was almost completely converted into a foramen by the ossified suprascapular ligament. In the Sikh, also, the bones were massive, in the one the suprascapular ligament was completely ossified, in the other partially so. In the Chinese, owing to the deep concavity of the superior border of the scapulæ, the area of the supraspinous fossa was greatly diminished and the notch was not specially differentiated at the base of the coracoid. In the Malay the suprascapular notch was fairly well marked.

In the female Lapp the superior border of the scapulæ was deeply concave, and the suprascapular notch scarcely differentiated; in the male the concavity of this border, though not so great, had the notch equally indistinct. In the male the axillary border was somewhat falciform. In each scapula of the Esquimaux the suprascapular notch was present, and the bones in one skeleton were pointed at the inferior angle.

Measurements of the Scapula.

The study of the modifications in the form and proportions of the scapula in the different races of men, based on exact measurements, with the view of establishing an anthropological character by the use of the numerical method, dates from the publication, in 1878, of M. Paul Broca's memoir on the scapular index, so that the literature of this subject is both recent and comprised in a small compass.

Broca, Paul, Sur les indices de largeur de l'omoplate chez l'homme, les singes et dans la série des mammifères. *Bull. de la Soc. d'Anthrop. de Paris*, February 21, 1878, ser. 3, t. i. p. 66, 1878.

Hamy, E. T., Étude sur un Squelette d'Aëta des Environs de Binangonan, Luçon. *Nouvelles Archives du Museum d'Histoire naturelle*, sér. 2, t. ii. p. 181, 1879.

Livon, Marius, De l'omoplate et de ses indices de largeur dans les races humaines. *Thèse inaugurale*, Paris, 1879.

Flower, W. H., and Garson, J. G., The Scapular Index as a Race Character in Man. *Journ. of Anat. and Phys.*, October 1879, vol. xiv. p. 13, 1880.

M. Broca obtained the length (height) of the scapula by measuring in a straight line the distance from the superior to the inferior angle; and the breadth of the scapula by measuring from the middle of the outer border of the glenoid cavity to the point where the spine of the scapula intersects the vertebral border. The latter dimension is in the fundamental morphological axis of the scapula, and corresponds closely to the line of attachment of the spine, and the bone attains a greater or less length by growth in the direction of either the supra- or infraspinous fossa. With these measurements he computed a scapular index as follows: $\frac{\text{breadth} \times 100}{\text{length}}$, length = 100. When the index is high the scapula is broad in proportion to its length, and *vice versa*. Again, he measured the distance from the inferior angle to the point where the scapular spine intersected the vertebral border, and obtained the relations between the breadth of the scapula and the

infraspinous length, by the following formula: $\frac{\text{breadth} \times 100}{\text{infraspinous length}}$. The product obtained is the infraspinous index of the scapula. M. Livon and Messrs. Flower and Garson have, in their inquiry into the scapular and infraspinous indices, adopted Broca's measurements.

As these measurements, with the indices derived from them, give the relations both of the entire length of the scapula and of its infraspinous length to the breadth of that bone, and thus fix certain important proportions, I have also employed them in this investigation. As Broca has shown, the scapular index is at its minimum in bipeds and at its maximum in quadrupeds, for whilst the length of the scapula exceeds the breadth in man, the reverse is the case in quadrupeds. An increase, therefore, of the scapular index in the human bone is an indication of a form of scapula more closely approaching to the ordinary mammalian type than when the index is low. The relation of the infraspinous index to the scapular index will vary with the variations in the relative length of the supra- (pre-) and infra- (post-) spinous fossæ. When the supraspinous fossa has a relatively great length to the infraspinous, then the infraspinous index is high, which is the normal mammalian proportion, but when the infraspinous index is low, as in the human scapula, then the infraspinous fossa dominates over the supraspinous.

Europeans.—The mean length of fourteen adult scapulæ of Frenchmen, measured by M. Broca, was 160·5 mm., the mean breadth was 105·7 mm., and the mean infraspinous length was 120·5 mm. M. Livon's measurements of seventy-three Frenchmen yielded a mean length of 168 mm., a mean breadth of 105·9, and a mean infraspinous length of 124·3 mm.; whilst in fifty-one Frenchwomen the corresponding dimensions were 135, 91·1 and 102·5. Messrs. Flower and Garson's measurements of 200 European scapulæ give the mean length 155·5 mm., mean breadth 101·4 mm., and mean infraspinous length 113·6 mm. These dimensions are smaller than those obtained by M. Broca, which is to be accounted for by their series containing a proportion of female scapulæ. In Broca's Frenchmen the mean scapular index was 65·9, and the mean infraspinous index was 87·7. The mean scapular index in M. Livon's Frenchmen was 63, and the mean infraspinous index was 85·4, whilst in the Frenchwomen the mean scapular index was 67·4, and the mean infraspinous index was 88·8, so that in women the scapula is broader in proportion to its length than in men. In Flower and Garson's Europeans of both sexes the mean scapular index was 65·2 and the mean infraspinous index was 89·4.

Australians.—I have examined twelve scapulæ belonging to six male skeletons. The maximum length of this bone was in the Queensland skeleton 168 mm., and the minimum in the West Australian from Perth 138 mm. In only one skeleton, that from Swan Hill, was the length of the right and left bones the same, and in the Perth skeleton they varied as much as 7 mm. The maximum breadth was in the right scapula of the Riverina skeleton, 109 mm., and the minimum in the scapulæ of the Manly Cove

skeleton, 88 mm. The breadth of the scapulæ in the same person was more frequently the same, or nearly the same, than was the length. The maximum infraspinous length was 130 mm. in the Queensland specimen, and the minimum was 102 mm. in the Eucla scapulæ. As a rule, the scapulæ were somewhat smaller that in male Europeans, for the mean length was 154·5 mm., the mean breadth was 97·3 mm., and the mean infraspinous length was 113·6 mm. The mean scapular index was 63, and the range was from 57 to 69·9; the mean infraspinous index was 87, and the range was from 74 to 101. In the two Australian males measured by M. Livon the mean scapular index was 63, and the mean infraspinous index was 86. In the twelve Australian scapulæ measured by Messrs. Flower and Garson the mean scapular index was 68·9 and the mean infraspinous index was 92·5. In their specimens these indices were materially higher than in M. Livon's and in mine, and a comparison of the two series showed this peculiarity, that whilst in theirs the scapular and infraspinous indices were higher than in Europeans, in mine they were distinctly below the European standard. My specimens and those of M. Livon were all males. It is possible that a majority of those measured by Flower and Garson may have been females, and if in the Australians the females have, as is the case in Europeans, higher indices than in the males, then the discrepancies in our respective measurements may be accounted for. Six Tasmanian scapulæ measured by the last-named anatomists had a mean scapular index, 60·3, and a mean infraspinous index, 81·4.

African Blacks.—In my Bush skeleton the right scapula was 133 mm., the left 137 mm. long, whilst their respective breadths were 96 and 95 mm. The scapular index in the one bone was 72, in the other 69, and the mean was 70·5. In the female measured by M. Livon the mean scapular index was 61·6, whilst Flower and Garson obtained a mean of 66·7 from six scapulæ. The two scapulæ in my skeleton yielded a mean infraspinous index of 102·5, those of Flower and Garson a mean of 90·7, and those of Livon only 76. In a Hottentot measured by M. Livon the mean scapular index of the two bones was 60, and the mean infraspinous index was 82. In four Negro skeletons, which I measured, the scapular index ranged from 63 to 78·9, and the mean of the eight bones was 70; in two Negresses the range was from 57 to 81, and the mean of the four bones was 68·5. In twenty-nine Negros measured by M. Livon the mean was 69, and in eight Negresses it was 71; in Broca's series of twenty-five skeletons, which may also have been included in Livon's measurements, the mean scapular index was 68; in six scapulæ measured by Flower and Garson the mean was 71·7. The infraspinous index in my specimens ranged from 80 to 115 in the Negresses, the mean being 97, and from 97 to 117 in the Negros, the mean being 105. In M. Broca's series of skeletons the mean index was only 93·8, in M. Livon's it was 96 both for the men and the women, and in Messrs. Flower and Garson's series it was 100·9.

Andaman Islanders and Negritos.—In three Andaman Islanders I found the scapular index to range from 66 to 75·8, with a mean of 70·6, which is almost in accordance with

the mean of 69·8 obtained by Flower and Garson from twenty-one scapulæ. The infraspinous index in my six scapulæ ranged from 94 to 115, and the mean was 102, whilst the mean in Flower and Garson's series was 92·7. In the Aëta Negrito measured by M. Hamy the scapular index was 64·9, and the infraspinous index was 88·6.

Pacific Islanders.—In my two Oahuan skeletons the mean scapular index was 78·8, and in my Maori from Otago it was 63·9. In thirteen Melanesians measured by M. Livon the mean was 69·8, and in sixteen Polynesians 66·6. Messrs. Flower and Garson give the mean index of two Papuan scapulæ as 64·5, and of two Tahitian as 70·3. The mean infraspinous index in my Oahuans was 117, and in the Otago Maori 88·5. M. Livon's Melanesians had a mean infraspinous index of 93·3, and his Polynesians of 89·4. In Flower and Garson's Papuan the mean infraspinous index was 87·6, and in their Tahitian 95·6.

Asiatics.—In my tall male Hindoo the mean scapular index was 68·9, and the mean of six Hindoos measured by M. Livon was 68·3. In my male Sikh the mean index was 68·5. In my Chinese the mean index was 66·8; the mean of three Chinese in M. Livon's table was 66·6, and of a single Japanese 64·9. In my Malay the mean scapular index was 64, and in M. Livon's Table the mean of two Malays was 74; in Flower and Garson's Table the mean of two Bornean scapulæ, possibly Malays, was 64·8; and in a Kubu from Sumatra, measured by Garson, this index was 72·9. The infraspinous index in my Hindoo was 95, and in Livon's series 92; in my Sikh it was 107; in my Chinese it was 88, and in Livon's series 90·8; in my Malay it was 93, in Livon's series it was 98·7, and in Flower and Garson's Bornean 89·8.

Lapp and Esquimaux.—In my two Lapps the mean scapular index was 59·5, in Livon's skeletons 63·7, and in Flower and Garson's skeleton 64·8. In my two Esquimaux skeletons the mean scapular index was 60·5, and in a similar number measured by Flower and Garson it was 61·6, whilst in a pair of Samoyed scapulæ it was 62·1. In my Lapps the mean infraspinous index was 85, in Livon's 83·7, and in Flower and Garson's 89·1. In my Esquimaux the mean infraspinous index was 82·2, in Flower and Garson's it was 80·5, and in a pair of Samoyed scapulæ it was 89·5.

I have not myself examined the scapulæ of any American Indians, but M. Livon has measured seventeen male and six female Peruvians, from which he has obtained a mean scapular index 66·5, and a mean infraspinous index 89·6. Dr. Garson, from the measurements of his Yahgan Fuegians, has obtained 64·3 as the mean of four men, and 66·2 as the mean of one woman.

It may now be convenient to give in a tabular form (Table XI.) the mean scapular and infraspinous indices obtained, by including the measurements by myself and other observers of the series of adult scapulæ referred to in the preceding paragraphs in one common average, the males and females not being differentiated from each other.

If we exclude the single Hottentot skeleton, where only two scapulæ were measured,

we shall find that the mean scapular index ranged from 60·3 in the Tasmanians, to 70·2 in the Andaman Islanders, and that the Europeans stand midway between these extremes at 65·3. From the very large number of Europeans which have been measured, it may

TABLE XI.

Race and Number of Scapulæ.	*Scapular Index.*	*Infraspinous Index.*
Europeans (462),	65·3	87·8
Australians (28),	64·9	88·5
Tasmanians (6),	60·3	81·4
Bush (10),	66·2	89·7
Hottentots (2),	60·0	82·0
Negros (about 100),	69·7	98·5
Andaman Islanders (27),	70·2	97·3
Negrito (2),	64·9	88·6
Melanesians (Livon, 26),	69·8	93·3
Polynesians (Livon, 32),	66·6	89·4
Hindoo and Sikh (16),	68·5	98·0
Chinese (8),	66·7	89·4
Malay (10),	68·9	93·8
Lapps (8),	62·6	85·9
Esquimaux (8),	61·0	81·3
Peruvians (Livon, 46),	66·5	89·6
Fuegians (9),	65·0	...

safely be assumed that this figure expresses accurately the European mean, though in the other races, excepting perhaps the Negro and the Andaman Islanders, it is doubtful whether the number of scapulæ measured in each race is sufficient to give a reliable average. For I gather both from my own measurements, and those of other observers, that the range of variation in the relative length and breadth of the scapula is very considerable in the same race, so that it needs a large number of bones to enable one to obtain an accurate idea of the mean of any race. Taking, however, the table as it stands, it will be seen that the Lapps, Esquimaux, and Tasmanians fall considerably below the European average; the Negros, Andaman Islanders, Melanesians, and Malays rise considerably above it, and the Australians, Bush, Polynesians, Peruvians, and Fuegians are in close approximation to the Europeans. As in the Anthropoid Apes and in mammals generally, the scapular index is higher than in man, it follows that the higher this index is in the human scapula, the more does it approach the ordinary mammalian standard, and it shows that the scapula has grown in breadth at a greater ratio than in length. If the averages of the black races given in the table are approximately correct, then considerable diversity exists amongst them in the relative length and breadth of the scapula, for whilst the Andaman Islanders, Negros, and Melanesians closely approach the mean

of the chimpanzee or gorilla,[1] the Australians and Bushmen are more like the Europeans, and the Tasmanians again are still further removed than the Europeans from the pithecoid proportions. The Lapps and the Esquimaux are also considerably below the European standard, so that in their scapular index, as well as in the tibio-femoral index, as will be shown in a subsequent chapter (p. 108), these extreme northern races are amongst the least pithecoid in their proportions.

Although I have given in the table the infraspinous index, yet I am doubtful if much value can be attached to it as a race character, for its range of variation in the same race is so extensive. Thus in the Australian scapulæ, which I measured, this index ranged from 74 to 101, and in the Negros from 80 to 117, and a difference of from 5 to 8 in the infraspinous index in opposite scapulæ of the same skeleton was not uncommon.

M. Livon in his thesis on the scapula, so frequently referred to, did not limit himself to such measurements as enabled him to compute the scapular and infraspinous indices, but determined the distance between several other points of the bone, and also calculated a supraspinous index. Although I have made the measurements for the determination of this index, I have not thought it necessary to incorporate them in this Report.

As, in the Anthropoid Apes, the relatively greater supraspinous fossa is associated with an obliquity of the spine of the scapula, much more marked than in the human scapula, in which the axis of the spine approaches to a right angle with the vertebral border of the bone, I was desirous of ascertaining if modifications in the direction of the spine of the scapula existed in the different races of men to such a degree as to establish a race character. I accordingly devised a goniometer which would, I thought, enable me to determine the angle which the axis of the spine formed with the vertebral border. I found, however, that this border had not unfrequently projections and depressions in it, which gave a degree of uncertainty to the base line, and made it difficult at times to determine, with precision, the angle which the axis of the spine formed with it. In twenty-five European scapulæ this *scapulo-spinal angle* ranged from 73° to 91°, and the mean of the series was 82°·5. In eleven Australian scapulæ the range was from 67° to 86°, and the mean of the series was 78°·2. In four scapulæ of chimpanzees the mean scapulo-spinal angle was 50°·5, and the mean of two orangs was 66°·5. On these measurements, therefore, the Australians were intermediate between the Europeans and Anthropoid Apes in this relation. But in stating this result it is right that I should say, for the reason already given, that I was not always satisfied with the accuracy of the angle obtained, though the mean probably furnishes a fair approximation to the relation of the two lines with each other.

[1] Messrs. Flower and Garson give 69·9 as the mean scapular index in the chimpanzee, and 72·2 as that of the gorilla; M. Livon states the index to be 71 in the chimpanzee and 70 in the gorilla.

If one compares the scapula with the pelvis one recognises that the latter fulfils in man a much more important office than the former. The pelvis presents both a surface for the attachment of important muscles, and is also the part of the skeleton through which the weight is transmitted to the lower limbs. The forces exercised on it are therefore more varied and more powerful than those which bear on the scapula. For the latter bone lies comparatively free in the flesh, and has its surfaces and processes developed essentially in relation to the various muscles which are attached to it, and it is not in man concerned in the transmission of weight. The external forces operating on the human scapula, which might lead to a modification in its form and proportions, would therefore be mainly, if not exclusively, in connection with its muscular attachments, more especially those muscles which are engaged in the abduction and elevation of the upper limb, and the rotatory muscles of the humerus. Should there be anything in the habits of one race of men which might require a particular group of scapular muscles to be used and developed to an extent far greater than in another race, then it is not unlikely that the area of attachment of those muscles in that race would be widened or lengthened to an extent greater than is the case in those races in which the same group is not similarly exercised, and the proportions of these parts of the scapula to the rest of the bone would in so far be modified. The arboreal habits of the ape require that it should use its upper limbs for purposes of climbing, and for swinging itself from one branch of a tree to another, so that the muscles engaged in the elevation of the upper limb require to be powerful; which would account for the greater development of the supraspinatus muscle and supraspinous fossa, and would probably lead also to the greater obliquity of the scapular spine than is the case in man. In a similar manner one would expect to find in those races of men, as the Australians, who climb trees in quest of food, or those natives of the interior of New Guinea, whose houses are built in the upper branches of lofty trees, a commensurate development of the elevatory muscles of the upper limb and of their respective areas of attachment. But in connection with this development the additional area might perhaps be obtained, either by an addition to the length or breadth of the surface, or perhaps both to its length and breadth.

SHAFT OF THE SUPERIOR EXTREMITY.

As a general rule, the bones of the upper limb of the aboriginal skeletons which I have examined had not the ridges and processes for the attachment of muscles of especial magnitude, so that they did not express great muscular development. In many instances the bones were slender and with smooth surfaces. This character was especially noticed in the Australian, Chinese, Andaman Islanders, Hindoo, and Negress skeletons. In the male Sikh the bones were much more powerful, and in the Te Aroha New Zealander, Bush, male Laplander, and Esquimaux they had a robust appearance. In no specimen was a supra-condyloid process or foramen present. An intercondyloid (supra-trochlear) foramen existed in both humeri of the Queensland Australian, left humerus of Sikh, left humerus of each of the Oahuans, right humerus of a female Andaman Islander, and all the humeri of two other Andaman Islanders, left humerus of Bushman, the humeri of the two Negresses, right humerus of one Negro, and both humeri of the larger male Hindoo. Of the fifty-eight humeri examined in these skeletons, the intercondyloid foramen existed, therefore, in eighteen specimens, being at the rate of 31 per cent., which is a very much larger proportion than one finds in the humeri of modern Europeans, in which it has been estimated by MM. Hamy and Sauvages as from 4 to 5 per cent.[1] Observations on its frequency in several aboriginal races have now been put on record. Thus M. Broca found it to be frequent in the humeri of the people of the stone period.[2] Professor Wyman states that in the Mound builders of the United States it has been seen in 31 per cent.,[3] and M. Topinard gives the proportion in Polynesians as 34 per cent., in Melanesians 14 per cent., in Negros 21 per cent., and in natives of the Grand Canary Islands as 25·6 per cent.[4] Professor Flower found it very common in female Andaman Islanders, occurring in eleven out of seventeen humeri, whilst it was only five times present in sixteen humeri of males. This defect in the ossification of the humerus, it may be noted, occurs frequently in races many of which exhibit, in the weight and massiveness of their crania, evidence of an almost exuberant ossification in that part of the skeleton.

In the Chinese and the female Hindoo, the upper epiphysis of the humerus and the lower epiphysis of both radius and ulna, were not fully fused with the shafts of their respective bones, for the line of demarcation between shaft and epiphysis was visible on the surface of each bone.

[1] Quoted by M. Topinard, reference below.
[2] *Bull. Soc. d'Anthropologie*, 1865.
[3] *Reports of Peabody Museum*, 1871.
[4] Éléments d'Anthropologié générale, 1885, p. 1015.

Measurements of the Bones.

The length of the bones of the shaft of the upper limb was taken on a Broca's osteometric board, made by M. Collin, Paris. I measured the maximum length of each humerus from the top of the head to the most projecting part of the trochlear surface. In each radius I measured the length from the top of the radius to both the base and the tip of the styloid process, and in each ulna from the summit of the olecranon to both the inferior articular surface and the tip of the styloid process. The measurement to the tip of the styloid process in both radius and ulna gives the maximum length of each of those bones. In taking these measurements I was desirous of ascertaining the absolute length of each bone, the relative length of the corresponding bones in opposite limbs of the same skeleton, and the proportionate length which the bones of the forearm bore to the bone of the upper arm in the same limb.

The longest humerus was in the right arm of one of the Negro skeletons, in which it measured 372 mm.; the longest humerus in each of the two other Negros was 339 and 324 mm., and in the two Negresses 331 and 307 mm.[1] In the male skeleton, presented by Dr. Anderson as a Hindoo, the left humerus was 370 mm. long; in the other male Hindoo each humerus was 318 mm., and in the female the right humerus was 285 mm. In the Sikh the right humerus was 354 mm., in the Chinese 298 mm., and in the Malay the left humerus was 307 mm. In the male Australians the maximum humerus was 352 mm., in the Riverina skeleton; then followed 348 mm. in the Queensland, 335 in the Manly Cove, 334 in the Eucla, 330 in the Perth, and 325 mm. in the Swan Hill skeleton; whilst in the female from West Victoria the right humerus was only 287 mm. The right humerus of the male New Zealander from Te Aroha was 335 mm., and the left in the Otago skeleton was 326 mm. In the one female Oahuan the maximum humerus was 311 mm., in the other 267 mm. In the male Esquimaux the right humerus was 343 mm., in the female 326 mm. In the male Lapp the right humerus was 299 mm., in the female 280 mm. In the Bushman the right humerus was 288 mm. long. The longest humerus in the Andaman Islanders was 281 mm. in one skeleton, 278 in another, 253 in a third, and 248 in a fourth.

The longest radius, the length of which was 287 mm., was in the right arm of the Negro skeleton which also had the longest humerus. In the other Negros the maximum radius was 273 and 258 mm., and in the Negresses 245 and 242 mm. In Dr. Anderson's male Hindoo the maximum radius was 282 mm., in the other male Hindoo 257, and in the female 233 mm. In the Sikh the longest radius was 267, in the Malay 250, and in the Chinese 227 mm. Both radii of the Queensland and the left radius of the Riverina skeleton measured 270 mm., and the maximum radius in the

[1] In Table XIV., p. 109, the maximum lengths of the humerus and radius in thirty of the skeletons which I have measured is recorded.

Eucla, Manly Cove, Swan Hill, and Perth skeletons was respectively 264, 259, 252, and 246 mm.; in the female the maximum length was 222 mm. The Otago skeleton had the longest radius in the New Zealanders, 263 mm., whilst in the Te Aroha specimen it was 252 mm. In one female Oahuan the maximum radius was 234 mm., in the other 211 mm. In the male Esquimaux the maximum radius was 239 mm., in the female 251 mm. In the male and female Lapp the longest radius was 207 mm. In the Bushman the right or longer radius was 220 mm. In one Andaman Islander the maximum radius was 225, in another 223 mm. The usual length of the styloid process in these specimens was 3, 4, or 5 mm.; but in the longest radius in the Negros, in the shorter male Hindoo, and in an Andaman Islander, it was 7 mm., and in another Negro it was 9 mm.

The longest ulna was in Dr. Anderson's male Hindoo, which measured 305 mm.; in the other male it was 275 mm., and in the female 248 mm. In the Sikh the maximum ulna was 297, in the Malay 265, and in the Chinese 247 mm. In the Negro, with the long humerus and radius, the maximum ulna, the right, was 301 mm.; in the other Negros 298 and 272 mm., and in the Negresses 261 and 258 mm. The Queensland skeleton, amongst the Australians, had the longest ulna, 292 mm., and then followed the Riverina 287, Eucla 280, Manly Cove 275, Swan Hill 264, and Perth 259 mm., whilst in the female from Victoria the right ulna was 232 mm. The right ulna from Te Aroha, New Zealand, was 279, and the left from Otago 278 mm. In one Oahuan the ulna was 258, in the other 230 mm. In the female Esquimaux the maximum ulna was 277, and in the male 265 mm. In the female Lapp the maximum ulna was 226, and in the male 220 mm. In the Bushman the right or longer ulna was 234 mm. In one Andaman Islander the longer ulna was 241, in another 239 mm. In many of the skeletons, as the Eucla, Perth, and Manly Cove Australians, the Malay, Andaman Islanders, and male Lapp, the Negros, Negresses, and Hindoos, the styloid process did not project more than 1, 2, or 3 mm. beyond the inferior articular surface; but in the Riverina skeleton it projected 6 mm., and in the Sikh 7 mm. beyond it.

I shall now speak of the relative length of the corresponding bones in the opposite limbs of the same person. The right humerus was longer than the left in the Sikh, Chinese, Manly Cove, Riverina, Perth, Swan Hill, and West Victoria Australians, in both Oahuans, the Bush, four Andaman Islanders, both Lapps, both Esquimaux, the female Hindoo, two Negros, and two Negresses. The left humerus was longer than the right in the Eucla and Queensland Australians, the Otago skeleton, a Negro, and Dr. Anderson's male Hindoo. The humeri were equal in length in the other male Hindoo. The differences in length on the two sides sometimes did not exceed 1, 2, or 3 mm. But in the Sikh, Manly Cove, an Andaman Islander, the male Lapp, and an Esquimaux it was 6 mm., in an Oahuan and Negro 7 mm., in the Negro with the longest humerus 8 mm., in the female Australian 10 mm., and in the female Lapp 12 mm.

The right radius was longer than the left in the Sikh, the Chinese, the Manly Cove, Perth, and Swan Hill Australians, both Oahuans, the Bush, two Andaman Islanders, the female Lapp, the three Hindoos, the male Esquimaux, two Negros, and one Negress. The left radius was longer than the right in the Riverina, Eucla, and West Victoria Australians, the Otago skeleton, male Lapp, female Esquimaux, and one Negro. The two radii were of equal length in the Queensland and an Andaman skeleton. The difference between the two radii was usually 1, 2, or 3 mm., but in one Negro it was 6 mm.; in another, viz., the one with the longest radius, it was 8 mm., and in the Otago skeleton 9 mm.

The right ulna was longer than the left in the Sikh, Chinese, Manly Cove, Perth, Queensland, and West Victoria Australians, one Oahuan, the Bushman, two Andaman Islanders, both Lapps, the male Esquimaux, the three Hindoos, a Negro, and a Negress. The left ulna was longer than the right in the Malay, Eucla Australian, Otago skeleton, female Esquimaux, a Negro, and a Negress. The bones were equal in length in the Swan Hill Australian, an Andaman Islander, and a Negro. The difference between the lengths of the two bones was usually not more than 1, 2, or 3 mm., but in the Chinese, Otago skeleton, and Bushman it rose to 6 mm.

That differences existed in the relative lengths of the forearm and the upper arm in the races of men was pointed out by Charles White at the end of the last century in a comparative study of the Negro and the European,[1] in which he found that the forearm in the former was longer in proportion to the upper arm than in the latter. Prof. Humphry also recorded, in his treatise on the Human Skeleton, a similar observation. M. Broca subsequently made more extended inquiries into this subject,[2] and showed that if the humerus were regarded as equal in length to 100, the mean length of the radius in fifteen Negros was 79·4, and in nine Europeans 73·9. I have, in estimating the proportionate length of the forearm to the upper arm in the same limb, in my series of skeletons, selected, when the bones were uninjured, the right limb, and have compared the maximum length of the humerus with that of the radius, the styloid process being included.[3] On the assumption that the length of the humerus was = 100, the proportionate length of the radius was obtained by the formula $\frac{\text{radial length} \times 100}{\text{humeral length}}$, the product is the *radio-humeral* or *antebrachial index*.

To furnish a standard of comparison for these exotic skeletons, I shall in the first instance state the indices obtained by the measurements of the bones of the shaft of the upper limb in Europeans as recorded by Humphry, Broca, Hamy, Topinard and Flower. Prof. Humphry's measurements of twenty-five skeletons gave a mean radio-

[1] An Account of the regular gradation in Man and in different Animals, &c., London, 1799.

[2] Sur les proportions relatives du Bras de l'Avant-bras, &c., in *Bull. de la Soc. d'Anthropologie*, April 3, 1862, t. iii.

[3] In Table XIV., p. 109, I have given the maximum length both of humerus and radius in my series of skeletons, the dimensions in most cases having been taken from the right limb.

humeral index 72·4. M. Broca[1] obtained 73·9 as the mean radio-humeral index of nine Europeans, five men and four women. M. Hamy,[2] who measured the maximum length of the humerus, obtained a mean of 72·1 in European skeletons. M. Topinard gives[3] the mean radio-humeral index of one series of eighty-five European male skeletons as 72·5, of another series of fifty-five as 73, and of a third series of ten as 74·7; the mean of the whole being 73·4; whilst the mean in twenty-six European women was 72·4. Professor Flower[4] states that the mean of fourteen European skeletons which he measured was 73·9, and this number corresponds exactly with the results obtained by M. Broca from the measurements of his nine skeletons.

In my series of six male Australians the radio-humeral index varied from 78 in the Eucla skeleton to 74 in that from Perth, and the mean of the series was 76·5, whilst in the single female the index was 77. The mean index of three Australians recorded by Topinard was 76·6, that of eleven skeletons measured by Flower was 76·5, that of four skeletons measured by Spengel in the Blumenbach collection in Göttingen was 76·4, in Ecker's young Australian the index was 73, and in Keferstein's old skeleton 79. From the measurements, therefore, of the above twenty-seven skeletons, we are in a position to state with some certainty that the mean radio-humeral index in the aboriginal Australians lies between 76 and 77, and that in this race, as in the Negros, the radius is longer in proportion to the humerus than in Europeans.

The radio-humeral index in two of the Oahuan female skeletons which possessed the upper limbs was 79 and 75 respectively, the mean being 77; and in two male New Zealanders it was 75 and 78, with a mean of 76·5. The measurements of the bones of the upper limb of some Pacific Islanders have also been taken by M. Topinard, who gives the mean radio-humeral index of eight New Caledonians at 76, and five Polynesians also at 76. Barnard Davis has given the radio-humeral index of a male Loyalty Islander as 77, of a male Tannese as 83, and Spengel[5] has recorded this index in an "Alfuru" as 79·7. Spengel has also given the mean lengths of the humerus in Fijians[6] as 315·5 mm., and that of the radius as 264 mm., which yield an index 83·6. E. Tüngel states[7] that the mean length of the humerus in the skeletons collected by Dr. A. B. Meyer in the neighbourhood of Rubi, at the south end of Geelvink Bay, New Guinea, was 313·8 mm.,

[1] M. Broca measured the length of the humerus from the head to the radial articular surface, which is somewhat less than the maximum length; so that the radio-humeral index which he obtained is a little higher than when the maximum length is taken.

[2] Les proportions du Bras and de l'Avant-bras in *Revue d'Anthropologie*, t. i. p. 91, 1872.

[3] Anthropology, English Translation, 1878, and Éléments d'Anthropologie generale, Paris, 1885.

[4] The references to authorities on the Bones of the Limbs, except when otherwise stated, are the same as those given in the Bibliography of the Pelvis, pp. 3, 4, 5.

[5] See Table, p. 96, in Supplement to Thesaurus Cranium, by Barnard Davis.

[6] *Journal des Mus. Godeffroy*, Heft. iv., 1873. I quote the mean length of the humerus and radius from Tüngel's Memoir, which yield the index stated above, though Tüngel himself places the relation of the radial to the humeral length as 79·3.

[7] Messungen von Skeletknochen der Papuas, *Mittheil. aus dem K. Zoolog. Museum zu Dresden*, Heft. i., 1877.

and the mean length of the radius was 233, which gave a radio-humeral index 74·2. It should be stated, however, that the specimens examined by Tüngel were not such as to furnish very accurately the proportion of the radius to the humerus, for though thirteen humeri were present there were only four radii, and it was not certain to which humeri they corresponded.

Two Tasmanian men measured by Topinard had a mean index of 78·7, whilst in two women the index was 78·6; in one Tasmanian woman measured by Barnard Davis the index was 80, whilst three Tasmanian men had a mean index 81; the average of the eight specimens being 79·6.

The radio-humeral index in my male Bushman was 76, and in a Bushman measured by G. Fritsch it was 74·5. In two Bush women measured by M. Topinard the mean index was 73·9, and in one measured by G. Fritsch it was only 68. From Professor Humphry's measurements of three Bushmen I have calculated an index 76·8. The mean of eight skeletons of both sexes was 73·8. The mean index in four male Kaffirs measured by G. Fritsch was 78·7, the range of variation in these skeletons being from 74·5 to 81; in a Hottentot woman examined by the same author the index was 71.

The mean radio-humeral index in my three Negros was 78·5, the range being from 77 to 80·5; the mean of my two Negresses was 76. From Professor Humphry's measurements of twenty-five Negros, probably skeletons of both sexes, an average index of 77·7 can be calculated. M. Broca obtained 79·4 as the mean index of fifteen skeletons, nine men and six women. M. Hamy states that the twenty-five skeletons which he measured gave a mean index 78·2. M. Topinard gives the mean of thirty-two Negros as 79, and of ten Negresses as 78·3. The mean of two Negros in the Blumenbach collection measured by Spengel was 82·8; and the Balumba Negro in the Barnard Davis collection had an index 85·7.

The mean index of my three Andaman Islanders, in which the bones of the forearm were preserved and fully ossified, was 81·2; in one Andaman woman measured by M. Topinard it was 81·7; and in twenty-nine skeletons of Andaman Islanders, measured by Professor Flower, this index was 80·6, being 81·5 for the men and 79·7 for the women.

In one of the two Negrito women measured by Meyer and Tüngel the radio-humeral index was 85, in the other 86; in the woman of the Aëta tribe, measured by Hamy, this index was 80; the mean of the three specimens was therefore 83·7.

In my two male Hindoos the mean radio-humeral index was 78·9, and in the female it was 81·7. M. Topinard gives 77·2 as the mean of four Hindoo men, and 75 as the mean of three Hindoo women. The mean index in my male Sikh was 75, in Barnard Davis's "Bariam Singh" it was 76, and in his Bhutea skeleton it was 77.

In my Chinese skeleton the radio-humeral index was 76; in a Chinaman measured by Meyer and Tüngel it was 80·5; in five Chinese and Annamite men measured by

M. Topinard it was 78, and in two Chinese and Japanese women it was 77·9; in a male Chinese recorded by Spengel it was 79·2; the mean measurements by Barnard Davis of two male Japanese was 82, and in a female Aïno the index was 75. The radio-humeral index in my Malay skeleton was 81, in a male Banda Islander in the Göttingen collection, recorded both by Keferstein[1] and by Spengel, it was 78·2, and in the Kubu skeleton measured by Garson it was 74·1.

In the male Esquimaux, which I measured, the radio-humeral index was 69·6, and in the female 76, whilst in a male Esquimaux measured by M. Topinard this index was 69·8. In a male Samoyed, also recorded by Topinard, this index was 72·9. In my male Lapp the radio-humeral index was 68, and in the female 74.

I have not myself had the opportunity of measuring the bones of the shaft of the upper limb in any skeleton of the American aborigines. Barnard Davis has given the radio-humeral index in an Illinois Indian as 80, in a South American Puelche Indian as 75, and in an ancient Peruvian also as 75. M. Topinard has recorded the radio-humeral index of five male South American Indians as 77·4, and of six females also as 77·4. Dr. Garson, in his recent memoir on the Yahgan tribe of the inhabitants of Tierra del Fuego, has placed the radio-humeral index of five male skeletons at 81·3.

From this general review of the results which have been obtained by those anatomists who have measured the relative lengths of the radius and humerus in different races of men, it is evident that an appreciable disparity exists in the lengths of these two bones, and that the forearm, in proportion to the upper arm, is longer in some races than in others. In estimating, however, what this disparity is, one experiences a similar difficulty to that which one had to contend with in the study of race differences in the pelvis, viz., the comparatively small number of specimens of some of the races which have as yet been measured, so that it is impossible to speak with certainty of the average index in them. Sufficient material, however, seems to have been collected to enable one to make a provisional grouping, based on these differences, in the radio-humeral index. At one end of the series we find the natives of Western Europe, with the Lapps and the Esquimaux, possessing a low index, and at the opposite end the Andaman Islanders, Negritos, and Yahgan Fuegians with a high radio-humeral index; whilst the most important and most numerous of the black races, some of the yellow races, and probably the Continental American Indians, occupy an intermediate position. The extremes are so far asunder that it seems possible to make three groups, as follows:—those in which this index is below 75, those in which it is 80 or upwards, and those in which the radio-humeral index ranges from 75 to 79·9, both inclusive. Those with a low index, *i.e.*, with a relatively short forearm, may be called *brachykerkic* (κερκίς, radius); those with a high index, *i.e.*, a relatively long forearm, may be called *dolichokerkic*; whilst those

[1] Bemerkungen über das Skelett eines Australiers, Dresden, 1865.

whose index is intermediate are *mesatikerkic*. Table XII. embodies this provisional arrangement, but, from the queries appended, it will be seen that I do not speak with confidence of the position of several of these races.

TABLE XII.

DOLICHOKERKIC. *Index* 80 or upwards.	MESATIKERKIC. *Index* 75 to 79.	BRACHYKERKIC. *Index* below 75.
Andaman Islanders.	Australians.	Europeans.
Negritos.	Tasmanians.	Lapps.
Fuegians.	Polynesians.	Esquimaux.
Melanesians ?	Melanesians ?	Samoyed ?
	Kaffirs.	Bushmen ?
	Negros.	
	Hindoos.	
	Sikh.	
	Chinese.	
	Malays ?	
	American Indians.	

Professor Humphry pointed out several years ago, in his treatise on the Human Skeleton, that the Negro presented more numerous approximations to the proportions of the fœtal than to those of the adult European, and that in the fœtus the forearm has greater relative dimensions than the upper arm. M. Hamy has measured[1] the upper limb in sixty-two European fœtuses and children from 2½ months to 13½ years, and has found a gradually decreasing proportion in the length of the radius to the humerus as the age advanced. In a fœtus of 2½ months, the proportion of radius was 88·8, the humerus being equal to 100; the mean proportion of radius in six fœtuses from 4 to 5 months was 80·4, and from 5 to 7 months 77·6; the mean in eleven new-born infants was 76·2; the mean in seven infants from 21 to 30 days was 74·5; and the mean in six children from 5 to 13½ years was 72·3. Those races, therefore, in which the adults have dolichokerkic proportions, approximate, in the relations of the forearm to the upper arm, to the embryo of a European before the end of the 5th month; those whose proportions are mesatikerkic to embryos after the 5th month and to new-born children; whilst those with brachykerkic proportions are like European children above 5 years of age and European adults.

[1] Recherches sur les proportions du Bras et de l'Avant-bras aux differents ages de la Vie, *Revue d'Anthropologie*, t. i. p. 79, 1872.

SHAFT OF THE INFERIOR EXTREMITY.

Both the femur and the tibia were examined in the several skeletons to see if any peculiarities existed in the shape of the bones. M. Broca directed attention some years ago to some femora in which the middle third of the shaft was prismatic and triangular, the lateral surfaces being concave, and the linea aspera projecting posteriorly as a strong raised ridge. Bones of this shape were termed *femur à pilastre* or *femur à colonne*. The femora from Cro-Magnon, near Les Eyzies, and those of the Guanches in the Museum of the Anthropological Society of Paris, were illustrative of this shape of femur, and M. Topinard has found the femora of the New Caledonians to possess a similar form.

In my series of Australian skeletons this variety of femur was seen to great advantage in those from the Riverina, Eucla, Manly Cove, and Queensland. In the Riverina skeleton the transverse diameter of the middle of the shaft of the right femur was 25 mm., and the antero-posterior diameter was 33 mm., which gives an index of 132; in the Eucla, Manly Cove, and Queensland skeletons this index was respectively 120, 120, and 127. In almost all the Australian femora the ridge from the linea aspera to the great trochanter to which the gluteus maximus is attached, was strongly marked; in some it was raised so as to form a low trochanter tertius, and the projection was accentuated by an elongated depression parallel to its outer side. In one adult Andaman Islander the prismatic form of the femoral shaft was very pronounced, and the same character was seen in the Oahuan, Esquimaux, and Lapp skeletons. I have also sometimes seen the shaft of the femur in Europeans in my dissecting room prismatic in shape. In five of seven New Zealand femora a peculiar flattening of the upper third of the anterior surface of the shaft immediately below the great trochanter was recognised. This was associated with, and apparently due to the projection outwards of an infra-trochanteric ridge, extending downwards from below the outer side of the great trochanter; but in these bones the middle of the shaft was not prismatic. A similar flattening was also observed in an odd femur, which, though it was presented to the museum along with some New Zealand bones, was said to be Australian. In the femora from a skeleton, which I obtained a number of years ago in a cave at Oban, Argyllshire, an equally well-pronounced flattening of the upper third of the shaft was seen, and the infra-trochanteric ridge formed a definite bulging quite distinct from and in front of the ridge leading from the great trochanter to the linea aspera.[1] The linea aspera was strong, but not so projecting as in the Australians. In the Oahuan femora, and in the Lapp and Esquimaux skeletons, the flattened anterior surface of the upper third of the shaft with the prominent external infra-trochanteric ridge was also present. In some of the

[1] This form of femur apparently corresponds with that found in a femur from a sepulchral cave at Perthi-Chwaren in Denbighshire, described by Mr. Busk in *Journ. Ethnol. Soc. Lond.*, January 1871. I described this Oban cave to the Anthropological Department of the British Association in 1871 (see *Reports* of Edinburgh meeting, p. 160, 1871).

femora the anterior aspect of the lower third of the shaft was raised almost into a ridge leading upwards from the outer lip of the patellar articular surface, which caused the shaft internal to that ridge to slope downwards and inwards towards the internal tuberosity. In the Lapp skeletons, in addition to the infra-trochanteric ridge, a low trochanter tertius was present. In one Hindoo skeleton and in the Malay a third trochanter was moderately developed. In the Hindoos, Sikh, and Chinese, the lateral surfaces of the shaft of the femur were not concave, and the linea aspera was not strongly ridged. The index of the relation of the antero-posterior and transverse diameters at the middle of the shaft of the femur in the tall Hindoo was 103 for the right and 111 for the left bone; in the Sikh 93 for the right and 103 for the left femur; in the Malay 104 for the left femur, the right having been broken; in the Chinese 104 for the right and 100 for the left bone. In the Bush femora the linea aspera was moderate, and the same remark applies to the Negro skeletons.

In the Anthropoid apes the linea aspera is very faintly marked, the shaft of the femur is not prismatic, but is antero-posteriorly compressed, and with the lateral aspects rounded. In an adult orang the transverse diameter of the middle of the shaft of each femur was 24 mm. and the antero-posterior diameter 18 mm., the index being only 75; in an adult chimpanzee the corresponding diameters were 27 and 21 mm., and the index was 77.

Of the femora, the indices of which have been given above, the Australians exhibit a much wider departure from the proportions of the shaft in the Anthropoid apes than do the skeletons of the Asiatics. The strength and projection of the linea aspera are to be associated with the development of the muscles engaged in retaining the equilibrium of the trunk on the thighs and hip joints, and in extending the knee joint, that is to say, groups of muscles which play an important part in the assumption and preservation of the erect posture.

The investigations both of Mr. Busk and of M. Broca demonstrated some years ago the tendency in primeval man, as shown in skeletons obtained in sepulchral caves in various parts of Western Europe, to have the shaft of the tibia laterally compressed. Conjoined with this lateral compression the posterior surface of the tibia was no longer flattened, but convex from side to side. To this form of tibia the term *platyknemic* has been applied. Similar observations have been made by Professor Jeffries Wyman on tibiæ from ancient mounds in the United States. Virchow has also called attention to the platyknemic type of tibia (although with certain differences) in an Oahuan, a native of New Britain, and in some skeletons from the Philippine Islands, including Negritos. M. Hamy recognised a lateral flattening in the tibiæ of his Aëta Negrito, although by no means so strongly as in European skeletons of the Stone Age. The occurrence of platyknemia in various races of men has recently been discussed by M. Kuhff.[1] In the tibiæ

[1] See Busk in Trans. Internat. Congress of Prehistoric Archæology, 1868, p. 161, and *Journ. Ethnol. Soc. Lond.*, January 1871; Broca in Mémoires sur les ossemens des Eyzies, Paris, 1868; J. Wyman in *Fourth Annual Report of Peabody Museum*, 1871; Virchow in *Verhandl. d. Berlin. Ges. f. Anthrop.* in *Zeitsch. f. Eth.*, 1872, Bd. iv. s. 207, and 1880, Bd. xii. s. 112; M. Hamy in *Nouvelles Archives du Muséum*, t. II. p. 209, 1879, also Reliquiæ Aquitanicæ; and Kuhff in *Revue d'Anthropologie*, 1881.

of the skeleton from the Oban bone cave, referred to in a preceding paragraph (p. 97), the shaft was decidedly platyknemic; the breadth of the middle of the shaft from the interosseous to the inner border was 19 mm., and the antero-posterior diameter at the same spot was 29 mm., the index was therefore 65·5, a proportion a little higher than that obtained by M. Broca as the mean, 64, of the tibiæ from the Caverne de l'Homme-Mort, Lozère, but not so high as the mean, 66, of the Guanche tibiæ from the Great Canary Islands.

I examined the tibiæ in my series of exotic skeletons with reference to the platyknemic form, and compared them with a well-formed European tibia. In the Oahuans, adult Andaman Islanders, and Bushman the tibial shafts were decidedly compressed, and the posterior surface convex, so that they were platyknemic, although not in the same marked degree as in the tibia from Cro-Magnon, near Les Eyzies, described by M. Broca, but more like those from Perthi-Chwaren figured by Mr. Busk. In many of the other skeletons also, as the New Zealanders, Lapps, Esquimaux, Hindoos, Sikh, and Malay, a tendency to the platyknemic form was distinctly recognisable. In some of the Australian skeletons, in one Hindoo, and in the Chinese the fibular articular area on the external tuberosity of the tibia was indistinct, and the same remark applies to the corresponding surface on the head of the fibula. In the Anthropoid apes the shaft of the tibia also possesses a certain amount of lateral compression, and the posterior surface is somewhat convex, but the anterior border of the bone is not sharp but rounded.

Measurements of the Bones.

The length of the bones of the shaft of the lower limb was taken by means of a Broca's osteometric board. In each femur I measured the maximum length of the bone between the head and the most projecting point of the inner condyle; the maximum trochanteric length from the same point of the inner condyle to the tip of the great trochanter; the length when both condyles were placed in contact with the vertical plane of the osteometric board, both to the summit of the head and to the tip of the great trochanter; these two last measurements constituting what the French anthropologists call its length in the oblique position. In each tibia I measured the length from the condylar articular surfaces both to the tip of the malleolus and to the base of the malleolus, where it articulates with the superior surface of the astragalus. The distance from the condylar articular surfaces to the tip of the malleolus I call the maximum length of the tibia. In these measurements my object has been to determine the absolute length of the femur and tibia, the relative length of the corresponding bones in opposite limbs of the same skeleton, the proportionate length which the tibia bears to the femur in the same limb, and the relative length of the femur to the humerus.

The longest femur was in the skeleton presented by Dr. Anderson as a male Hindoo, in which the right thigh bone measured in its maximum length 509 mm.; in the other male

Hindoo the left femur was 460 mm., and in the female 408 mm.[1] In the Sikh the right femur was 498 mm., in the Chinese the left femur was 420 mm., and in the Malay 450 mm. long. In the Riverina Australian the right femur was 496 mm., in the Queensland skeleton each femur was 492 mm., the maximum femur in the Eucla skeleton was 468 mm., the Manly Cove 467 mm., Swan Hill 458 mm., Perth 452 mm., and in the femur from West Victoria 404 mm. The maximum femur in the New Zealanders was 462 mm. in the left femur from Te Aroha, in the left femur from Otago 460 mm., whilst in another New Zealander the length was only 425 mm., but the bones were robust. In the female Oahuans the longest femur was 432 mm., and the shortest 391 mm. The longest femur in the three Negros was 498 mm., the shortest 464 mm., and in the two Negresses the longest was 462 and the shortest 430 mm. In the male Esquimaux the longest femur (left) was 435 mm.; in the female it was 428 mm. In the male Lapp the maximum femur was 408 mm., in the female 362 mm. In the Bushman both femora were 420 mm. In two of the Andaman Islanders the left femur attained a length of 395 mm., but in another the maximum length was as low as 363 mm.

The differences between the maximum length of the femur and the maximum trochanteric length ranged from 26 mm. in the right femur of the Riverina Australian to 6 mm. in the right femur of one of the Negros. In eighteen of the sixty-two femora measured the total maximum length exceeded the maximum trochanteric length by 20 mm. or upwards; in forty-four specimens the maximum length was less than 20 mm. in excess of the trochanteric, and in three of these, being Negro femora, it was less than 10 mm. When these two diameters approach each other, the approximation in length expresses either an elongation of the great trochanter in connection with the insertion of the muscles of the buttock; or a diminution in the angle between the neck and shaft of the femur, so that it was almost a right angle. The total maximum length exceeded the length in the oblique position by as much as 9 mm. in the two Negresses, 8 mm. in the female Esquimaux, 7 mm. in the female Oahuans, a male New Zealander, and two male Australians; in one male Hindoo and in one male Andaman Islander these two diameters were equal; as a rule the total maximum length was not more than 3 or 4 mm. in excess of the length in the oblique position, and the differences between them expressed the greater or less projection of the inner condyle beyond the plane of the outer condyle.

The longest tibia was in Dr. Anderson's Hindoo skeleton, in which the right tibia in its maximum length measured 429 mm., but in the other male Hindoo it was only 398 mm., and in the female the left tibia was 348 mm. In the Sikh the right tibia was 403 mm., the Chinese was 331 mm., and the Malay 372 mm. In the male Australians the longest tibia was 423 mm. in the Riverina, 421 mm. in the Queensland, 394 mm. in the Swan Hill, 392 mm. in the Eucla, 387 mm. in the Perth, and 384 mm. in the Manly

[1] In Table XIV., p. 109, the maximum length of the femur and tibia in thirty of the skeletons which I have measured is recorded.

Cove skeletons; whilst in the female from West Victoria the maximum length of the tibia was only 340 mm. The maximum tibia in the left leg of the Otago New Zealander was 401 mm., and in the skeleton from Te Aroha 365 mm.* In one female Oahuan the tibiæ each measured 362 mm., in the other the maximum tibia was 332 mm. The maximum tibia in the three Negros was 419 mm., and the minimum 410 mm., and in the two Negresses the maximum was 385 and the minimum 348 mm. In the male Esquimaux the maximum tibia was 375 mm., in the female 347 mm. In the male Lapp the maximum tibia was 307 mm.; in the female each tibia measured 290 mm. In the Bushman both tibiæ measured 334 mm. In one Andaman Islander the right tibia (an odd bone) was 362 mm. long, in another 337 mm., in a third the left tibia was 336 mm., in a fourth 296 mm. In seventeen of the fifty-eight tibiæ measured the malleolus projected 10 mm. beyond the inferior articular surface of the tibia: in twenty-four specimens the projection was less than 10 mm.—the shortest malleoli being in the male Esquimaux, where the right was only 6 mm. and the left 5 mm. long; in seventeen specimens the malleolar projection was more than 10 mm., and the skeletons in which they reached their maximum were the Sikh, in which both internal malleoli were 13 mm., and the right tibia of the Queensland Australian, and the left tibia of the tallest Hindoo, in each of which the malleolus was 14 mm. long. In none of the tibiæ was the spine included in the length of the bone, as Broca's osteometric board provides for the length being taken from the condylar articular surfaces.

In the next place I shall direct attention to the relative length of the corresponding bones in opposite limbs of the same skeleton. The right femur was longer than the left in the Sikh, a male Hindoo, one male Australian, one female from Oahu, the male Lapp, and three Negros. The left femur was longer than the right in a male and female Hindoo, in the Chinese, one female and four male Australians, two New Zealanders, three Andaman Islanders, one Oahuan, a female Lapp, two Esquimaux, and one Negro. The right and left femora were equal in length in a male Australian, a New Zealander, and in the Bush skeleton. Frequently the difference in length between opposite femora was not more than 1, 2, or 3 mm.; but in the Chinese the left femur was 5 mm. longer than the right, in a Negro and male Hindoo the right femur was 5 mm. the longer, in a male Australian, a male New Zealander, and a male Hindoo the left femur was 6 mm. the longer, in an Andaman Islander the left femur was 7 mm. the longer, and in a female Australian it was 12 mm. the longer.

The right tibia was longer than the left in the Sikh, two male Hindoos, the Malay, Chinese, a male Andaman Islander, four male Australians, and two Negros. The left tibia was longer than the right in the female and two male Australians, a female Hindoo, one Oahuan, a New Zealander, two Andaman Islanders, a Lapp, and both Esquimaux. The right and left tibiæ were equal in length in an Oahuan, a Bush, a Lapp, and a Negro skeleton. Usually the differences in length were only 1 or 2 mm., but in the Riverina Australian

the right tibia was 8 mm. longer than the left, in a Negro it was 5 mm. the longer, and in an Andamanese the left tibia was 6 mm. longer than the right.

As the femur and tibia varied therefore, not unfrequently, in their maximum length in the opposite limbs of the same skeleton, it became a matter of interest to inquire if, in the limb where the femur was the longer, in that same limb the tibia was shorter than the corresponding bone in the opposite limb, so as in the erect posture to restore the balance between the two limbs and make their length uniform. In working out this question, I thought that more accurate results would be obtained if I did not take the maximum length of each bone, but measured the length of the femur in the oblique position, and that of the tibia between its condylar and astragaloid articular surfaces, as these dimensions more accurately expressed the length of the bones in their relation to the erect attitude, than did the maximum length, in which the malleolar process was included, and the femur was not inclined in its proper position. In several of the skeletons, from some defect or other, either in the femur or tibia of one of the limbs, the comparison could not be made, but there remained twenty-six skeletons of various races in which the comparative length of both these bones in opposite limbs was obtained. The dimensions are given in Table XIII.

Table XIII.

	Australians.													
	Manly Cove.		Riverina.		Encla.		Perth.		Queensland.		Swan Hill.		W. Victoria ♀.	
	R.	L.	R.	L.	R.	L.	R.	L.	R.	L.	R.	L.	R.	L.
Oblique length of femur,	457	461	492	491	461	465	449	455	485	485	453	455	402	415
Condylar-astragaloid length of tibia,	372	374	411	403	382	380	375	377	407	407	385	383	330	332
Length of shaft,	829	835	903	894	843	845	824	832	892	892	838	838	732	747
Tibio-femoral Index,	*81*		*83·5*		*81·7*		*82·8*		*83·9*		*84·9*		*80*	
	Otago.		Oahu A ♀.		Oahu B ♀.		Bush.		Andaman.		Andaman.		Andaman.	
	R.	L.	R.	L.	R.	L.	R.	L.	R.	L.	R.	L.	R.	L.
Oblique length of femur,	449	456	384	388	425	422	416	417	386	392	393	395	362	363
Condylar-astragaloid length of tibia,	390	394	322	324	354	353	328	325	320	326	325	325	280	287
Length of shaft,	839	850	706	712	779	777	744	742	706	718	718	720	642	650
Tibio-femoral Index,	*86*		*83*		*83*		*78·8*		*83*		*82*		79	
	Negro.		Negro.		Negress.		Sikh.		Hindoo.		Hindoo.		Hindoo ♀.	
	R.	L.	R.	L.	R.	L.	R.	L.	R.	L.	R.	L.	R.	L.
Oblique length of femur,	462	464	496	490	428	421	495	494	504	504	451	458	403	405
Condylar-astragaloid length of tibia,	405	404	407	406	343	338	390	388	418	412	386	382	335	336
Length of shaft,	867	868	903	898	771	759	885	882	922	916	837	840	738	741
Tibio-femoral Index,	*87*		*89*		*80*		*78·8*		*82·9*		*83*		*82·9*	
	Lapp.		Lapp ♀.		Esquimaux.		Esquimaux ♀.		Chinese.					
	R.	L.	R.	L.	R.	L.	R.	L.	R.	L.				
Oblique length of femur,	403	402	357	361	429	433	418	422	411	417				
Condylar-astragaloid length of tibia,	295	297	280	282	368	370	336	337	319	320				
Length of shaft,	698	699	637	643	797	803	754	759	730	737				
Tibio-femoral Index,	*73·8*		*78*		*85*		*79·8*		*76·7*					

An examination of this Table will show that although there is sometimes a compensation for the greater length of the femur of one side in an increased length of the tibia on the opposite, yet that not unfrequently the femur and tibia of the one limb are both longer than the corresponding bones in the opposite limb, so that the shaft of the one limb is appreciably longer than the shaft of the other. In seven skeletons the bones of the shaft of the right limb were longer than the left; in seventeen the left bones were longer than the right, and in two they were equal. In eleven of the twenty-six skeletons the femur and tibia in the one limb were either equal to or not more than 3 mm. longer than the corresponding bones in the opposite limb, in two skeletons there were 5 mm. of difference, in five skeletons 6 mm., in one 7 mm., in two 8 mm., in one 9 mm., in one 11 mm., in two 12 mm., and in one 15 mm. of difference. In six limbs the right femur was longer than the left, in eighteen the left was longer than the right, in two they were equal. In nine limbs the right tibia was longer than the left, in fifteen the left was longer than the right, in two they were equal.

That inequalities existed in the length of the lower limbs in the same person was pointed out a few years ago by the American surgeons, Drs. Wight and Cox, and attention has subsequently been directed to this matter, owing to its surgical importance, by several other investigators. In 1879 Dr. Garson made a special analysis[1] of the length of the femur and tibia in seventy skeletons of various races of men in the Museum of the Royal College of Surgeons of England. His method was somewhat different from that which I have adopted, as he has included both the spine and malleolus in the length of the tibia, and has taken the maximum length of the femur and not the length of the bone in the oblique position. His results, however, do not differ very materially from those which I have obtained. In 10 per cent. of his series of skeletons the limbs were symmetrical; in mine, 7·7 per cent. In 35·8 per cent. of his series the right limb was longer than the left; in mine, 26·9 per cent. In 54·3 per cent. of his series the left limb was longer than the right; in mine, 65·4 per cent. When the difference is only a few millimètres, compensation might be provided for in the living person by a slight difference in the vertical diameter of the opposite astragalus or os calcis, or of the fatty pad of the heel, or in the inclination of the pelvis, unless it should prove to be the case that inequality in the length of the limbs in the living person is the normal condition. When the difference is 6 or 8 mm. or upwards, the inequality is so marked that it is difficult to see how compensation can be obtained by modifications in any of the above anatomical conditions.

Table XIII. is also instructive because, as it gives the length which the shaft of the limb would have had in the erect attitude, it enables one to form an estimate of the height both of the individual, and, where several skeletons belong to the same race, of the average height of the race. As the Table includes the measurements of a few tall persons as

[1] *Journ. of Anat. and Phys.*, vol. xiii. p. 502, July 1879.

well as those of races short in stature, the range in the length of the femur and tibia was very remarkable. The tallest skeleton was that of the male Hindoo, presented to the Anatomical Museum of the University of Edinburgh by Dr. John Anderson, in which the shaft of the right limb was 922 mm. in length. On the supposition that the stature of the individual is twice the length of the femur and tibia, then the height of this man would have been 1844 mm., or 6 feet. In the Sikh the length of the right femur and tibia was 885, which by the same rule would give 1770 mm., or 5 feet 9¾ inches, as his approximate height. In both the Riverina Australian and in one of the Negro skeletons the right femur and tibia measured 903 mm., which by the same rule would give 1806 mm., or 5 feet 11 inches, as the approximate height of each of these persons. Dr. G. More Reid, by whom the Riverina Australian skeleton was presented to me for the University Museum, told me that this man, the chief of his tribe, was 5 feet 10 inches in height. The length of the femur and tibia in the Queensland skeleton was 892 mm., but both this and the Riverina skeleton were exceptionally high for the Australian aborigines, as in none of the other four male skeletons of this race did the conjoint length of these bones exceed 845 mm., and their mean in these four males was 835 mm. In the valuable Table VI. of the stature of the races of men, compiled by the Anthropometric Committee of the British Association,[1] the mean stature of the adult male Australian aborigines is given as 5 feet 5·68 inches, or 1669 mm., which, on the basis of the stature being twice that of the femur and tibia, would require for these bones conjointly a mean length of 834·5 mm., which corresponds with the mean of the four male Australians from Manly Cove, Eucla, Perth, and Swan Hill.

The Lapps and Andaman Islanders were in striking contrast, in the length of the bones of the shaft of the lower limb, to the skeletons just referred to. In the male Lapp the left femur and tibia measured 699 mm., which by the above rule would give a stature of 1398 mm., or 4 feet 7 inches. In the female Lapp, by a similar computation, the stature would have been only 1286 mm., or 4 feet 2½ inches. In the Table of the Anthropometric Committee the mean height of the adult male Lapp is stated, on the authority of Horch, to be 1500 mm., or 4 feet 11 inches. The mean height of three males measured by Garson[2] (the thickness of the soles of the boots being deducted) was 5 feet ½ inch; so that it is clear either that my male Lapp was much below the average, or that the bones of the shaft of the lower limb do not in this race bear so definite a relation to the stature as in the Australians, and on this point I may refer to an observation by Garson, who states that the lower limbs are short in proportion to the size of the trunk as compared with Europeans generally. In the Andaman Islanders the longest shaft in one skeleton was 718 mm., in another 720 mm., in a third 650 mm., which would give for the latter a stature of 1392 mm., or 4 feet 7 inches, which is below the average of 4 feet 10

[1] *Rep. Brit. Assoc.*, 1883, p. 270.

[2] Physical Characteristics of the Lapps, *Journ. Anthrop. Inst.*, vol. xv. p. 235, 1885.

inches obtained by Dr. Brander[1] from the measurement of fourteen men, though M. de Quatrefages[2] places the height of the males of this race at 1436 mm., or 4 feet 8½ inches.

In one of the Sandwich Island women from Oahu the maximum length of the shaft of the limb was only 712 mm., but in the other it reached 779 mm., giving a computed stature in the one case of 1424 mm., or 4 feet 8 inches, and in the other 1558 mm., or 5 feet 1¼ inch. In the Bushman the maximum shaft was 744 mm., and the computed stature was 1488 mm., or 4 feet 10½ inches, which is higher by 147 mm. than the mean stature of the race as given in the Table of the Anthropometric Committee above referred to. The computed stature of the Otago Maori was 1700 mm., of the Malay 1616 mm., of the male Esquimaux 1606 mm.; the Malay approximated to the mean of the race as given by the Anthropometric Committee, but the Maori and Esquimaux were both appreciably below the average stated in their Table VI.

From the data provided in my Table XIII. the proportionate length of the leg to the thigh in the same limb may be calculated. On the assumption that the length of the femur = 100, the proportionate length of the tibia may be obtained by the formula $\frac{\text{tibial length} \times 100}{\text{femoral length}}$, the product is the *tibio-femoral index*.

To begin with, I shall refer to the results obtained by Professors Humphry, Flower, and M. Topinard from the measurements of these bones in Europeans. Humphry measured twenty-five European skeletons, and obtained 17·88 inches as the mean length of the femur and 14·4 inches as the mean length of the tibia; the mean tibio-femoral index of these specimens was 80·5. Flower states that the average tibio-femoral index of fourteen Europeans measured by himself was 82·1. Topinard gives the mean of fifty-five European men as 81·1, and a second series of ten skeletons as 80·4; whilst the mean of seventeen European women was 80·8. The difference between the results obtained by these anatomists is doubtless due to Professor Flower including the spine of the tibia in the length of that bone, which necessarily increases the value of the index, whilst M. Topinard omits the spine from his measurements.

In computing the tibio-femoral index in my specimens, I have made the calculation from the longer of the two limbs, the measurements of which are given in Table XIII., but in addition I have obtained this index in the skeleton of the Malay, the Te Aroha Maori, an Andaman Islander, a Negro and a Negress, in which one limb only was perfect.

In my series of six male Australians the tibio-femoral index ranged from 81 in the Manly Cove to 84·9 in the Swan Hill skeleton, and the mean of the series was 82·96; whilst in the only female skeleton this index was 80. The mean index of eleven Australians measured by Flower was 84·9; the mean of three Australians recorded by Topinard was 82·1; that of four Australians measured by Spengel 83·2; the index of

[1] *Proc. Roy. Soc. Edin.*, p. 415, Session 1879-80.

[2] Étude sur les Mincopies, in *Revue d'Anthropologie*, t. i. p. 53, 1872.

Ecker's Australian was 85, and of Keferstein's 82. The mean tibio-femoral index of this series of twenty-seven Australian skeletons is therefore 83·3. It should be stated, however, that the various measurements by myself and these other anatomists have not been made in precisely the same way; for both Ecker and Flower take the maximum length of the bones, both the spine and malleolus of the tibia being included; Spengel has apparently followed the same plan; Keferstein, whilst giving the maximum length of the femur, measures the tibia between the two articular surfaces, and thus excludes both spine and malleolus; the index recorded by Topinard was obtained from the maximum length of the femur, and from the tibia between the condylar articular surface and the tip of the malleolus. For the reason stated on p. 102, I have taken a somewhat different measurement in constructing Table XIII., but I have also calculated the mean index of my six male Australians according to the method of M. Topinard, and have obtained 84 as the index.[1] It follows, therefore, that according to this method a somewhat higher index is obtained than on the plan followed in constructing Table XIII., and this index would have been yet further increased if the spine of the tibia had been included in the length of that bone. These differences in the method of measurement and in the computed indices are to be kept in mind in the comparison of my observations with those of other anatomists, though my own observations are of course comparable with each other.

The tibio-femoral index in the two female Oahuans was 83 in each skeleton. In the Otago Maori it was 86; but in the left limb of the Maori from Te Aroha it was only 77·7, the tibia being unusually short. M. Topinard's measurements of five male Polynesians yield an index of 82·2, eight New Caledonians of 83·1, and three female New Caledonians of 84·5. Barnard Davis's Loyalty Islander had an index of 82, and his Tannese 80.[2] In Spengel's "Alfuru" the index was 85·9. The mean length of the femur in the Fiji Islanders measured by Spengel was 442 mm., and that of the tibia 362·4 mm., which gave an index of 81·8. Forty-four femora and twenty-eight tibiæ of Papuans were collected near Rubi, New Guinea, by Dr. Meyer; Tüngel's measurements of these bones gave, in the adult males, the mean length of the femur as 443·45 mm., and that of the tibia as 364·6 mm., the index being 82·2.

In two Tasmanian men measured by M. Topinard the mean tibio-femoral index was 83·6, and in two women it was 82·3; in skeletons measured by Barnard Davis this index was 80 in a woman, and the mean in three men was 85.

The tibio-femoral index in my male Bushman was 78·8; in a man measured by G. Fritsch the index was 82, and in a woman 79·5; in two Bushwomen recorded by M. Topinard the mean index was 85·8; from the measurements of three skeletons (sex not stated) given by Professor Humphry an index of 86 has been computed. In four male

[1] The maximum lengths are given in Table XIV., p. 109.

[2] Barnard Davis's measurements record the "extreme length" both of femur and tibia, as also do those of E. Tüngel.

Kaffirs measured by G. Fritsch the tibio-femoral index ranged from 80 to 83, the mean being 81·5. In a Hottentot woman he obtained an index of 79, and from Wyman's measurements of a male Hottentot I have calculated an index of 87.

The mean tibio-femoral index of my three Negros was 85·9, and the range of variation was from 82 to 88·7; the mean of my two Negresses was 81·5. From Professor Humphry's measurements of twenty-five Negros (sex not stated) I have calculated an index of 84·7. Two Negros in the Blumenbach collection, measured by Spengel, had the indices 85·5 and 82·2 respectively, and the Balumba Negro from the Gaboon measured by Barnard Davis had an index of 85. In M. Topinard's table the mean index of thirty-two Negros is 82·9, and of ten Negresses 84·4.

The mean index of four Andaman Islanders which I have measured[1] was 81·2, the extremes being 79 and 83. In the much more numerous series of skeletons examined by Professor Flower an index of 84·4, being exactly the same in both sexes, was obtained by his method of measurement.

In a male Negrito measured by Virchow,[2] the tibio-femoral index was 87, but it should be stated that the superior spine was included in the length of the tibia.

In one of the female Negrito skeletons measured by Meyer and Tüngel, the tibio-femoral index was 74·7, in the other 88; in M. Hamy's specimen it was 86 (the malleolus being included). The mean tibio-femoral index of these four Negrito skeletons was 83·9.

In my three Hindoos the tibio-femoral index was practically the same in each skeleton, 83; M. Topinard has given 83·9 as the mean index of three female Hindoos, and 82·8 as the mean index of four "Noirs de l'Inde." The index in my male Sikh was 78·8; in Barnard Davis's skeleton it was 77, and in his Bhutea it was 78.

In my Chinese skeleton this index was 76·7; in the Chinaman measured by Meyer and Tüngel it was 80; in five male Chinese recorded by M. Topinard the mean index was 80·2; whilst Spengel's measurement of the male skeleton in the Blumenbach collection gave an index of 82·3. In six Tartars in M. Topinard's table the mean tibio-femoral index was 79·6.

The tibio-femoral index of my male Malay was 80·7; in two male Javanese measured by Barnard Davis this index was 80 and 87 respectively; in a female Javanese in M. Topinard's table it was 85·2; the index of the Banda Islander's skeleton, according to Keferstein's method, was 83, and according to Spengel's, 85; the index in Garson's Kubu skeleton was 80·7. The Aïno skeleton measured by Barnard Davis was 76·8.

In my male Esquimaux the index was 85, and in the female 79·8; but in the male measured by M. Topinard it was 78·7; in his male Samoyed this index was 79·8. In my male Lapp the tibio-femoral index was only 73·8, and in the female 78.

In the aborigines of America, Barnard Davis has obtained a tibio-femoral index of

[1] These include a specimen not in Table XIII., in which the right femur was perfect, but the left was broken.

[2] *Verhandl. der Berlin. Ges. f. Anth.* in *Zeitsch. f. Ethn.*, Bd. iv. s. 208, 1872.

83 in a male Illinois, 81 in a male Puelche Indian, 84 in an ancient Peruvian; and M. Topinard has given 84·1 as the mean index of five South American men, and 83·1 as that of six South American women. The mean tibio-femoral index in the Yahgan Fuegians measured by Dr. Garson was 84·7.

A comparison of the several indices, computed from the measurements of the skeletons of the various races now examined, shows that considerable diversity exists in the proportionate length of the tibia and femur, so that in some the leg approaches nearer to the length of the thigh than in others. In attempting, however, to form an estimate of the disparity which exists between different races, one is met, not only with the difficulty which one experienced in comparing the proportionate lengths of the forearm and upper arm, viz., the small number of specimens of some of the races that have as yet been measured, but with the different methods of measurement which have been employed by anatomists, so that they cannot at all times be compared with each other. Hence, I do not feel prepared with the requisite data to make even such a preliminary grouping of these races, based on the proportional length of the leg and thigh, as I ventured to do, though with much diffidence, in the section on the superior extremity. As it is obvious, however, that in some races the leg is longer in proportion to the thigh than in other races, some people may be called long-legged *dolichoknemic* (κνήμη, tibia), others short-legged, *brachyknemic;* the word leg being used in its strict anatomical sense to express that segment of the lower limb which lies between the knee and ankle joints.

If we assume a tibio-femoral index, 83, as marking the division between the proportionally long-legged and short-legged, then we may say that those races, in which the mean index is 83 or upwards, are dolichoknemic, and amongst these we might rank the Australians, Tasmanians, Negros, Andaman Islanders, Negritos, American Indians, and Yahgan Fuegians; possibly also the Melanesians, though their exact position, as well as that of the Polynesians and Malays, is doubtful. On the other hand, when the mean tibio-femoral index is below 83, the race may be said to be brachyknemic, and in this group we might place Europeans, Chinese, Tartars, Lapps, Esquimaux, Samoyeds, possibly the other tribes occupying the most northern part of the continent of Asia, and the Mongolian race generally.

In the next instance I shall proceed to the comparison of the extreme lengths of the humerus and radius with those of the femur and tibia in the same skeleton, a line of investigation which was introduced a number of years ago by M. Broca.[1] If we assume the extreme length of femur + tibia (spine omitted) to = 100, then an *intermembral index* may be computed as follows:— $\frac{\text{humerus} + \text{radius} \times 100}{\text{femur} + \text{tibia}}$.

[1] Sur les proportions relatives des membres supérieurs et des membres inferieurs chez les Nègres et les Europeens, &c., *Bull. de la Soc. d'Anthropologie*, ser. 2, t. ii. p. 641, November 21, 1867.

To bring the facts on which this comparison is made into convenient compass, I have compiled Table XIV., in which the extreme lengths of the bones in the right upper and lower limbs are given in millimètres, though in a few instances, where the right limb was imperfect, the dimensions have been taken from the limb on the left side.

TABLE XIV.—Maximum Length of Bones of Shafts, Spine of Tibia excluded.

		Femur.	Tibia.	F. + T. Total.	Humerus.	Radius.	H. + R. Total.	*Intermembral Index.*
Australians.	Manly Cove,	464	382	846	335	259	594	*72·0*
	Riverina,	496	423	919	352	268	620	*67·4*
	Eucla,	465	392	857	331	260	591	*68·9*
	Perth,	452	385	837	330	246	576	*68·8*
	Queensland,	492	421	913	347	270	617	*67·5*
	Swan Hill,	457	394	851	325	252	577	*67·8*
	W. Victoria, ♀,	404	339	743	287	221	508	*68·3*
	Oahu, A ♀, Sandwich Islands,	391	330	721	267	211	478	*66·2*
	Oahu, B ♀, Sandwich Islands,	432	362	794	311	234	545	*68·6*
	Te Aroha, New Zealand,	462	365	827	335	252	587	*70·9*
	Otago, New Zealand,	454	400	854	325	254	579	*67·8*
	Bushman,	420	334	754	288	220	508	*67·3*
	Negro,	464	412	876	339	273	612	*69·8*
	Negro,	468	410	878	320	252	572	*65·1*
	Negro,	498	419	917	372	287	659	*71·8*
	Negress,	462	385	847	331	242	573	*67·6*
	Negress,	434	353	787	307	242	549	*69·7*
	Andaman,	394	337	731	278	225	503	*68·8*
	Andaman,	388	330	718	281	223	504	*70·1*
	Andaman,	363	290	653	248	207	455	*69·6*
	Hindoo,	509	429	938	365	282	647	*68·9*
	Hindoo,	454	398	852	318	257	575	*67·4*
	Hindoo, ♀,	406	345	751	285	233	518	*68·0*
	Sikh,	498	403	901	354	267	621	*68·9*
	Chinese,	415	331	746	298	227	525	*70·3*
	Malay,	450	372	822	307	250	557	*67·7*
	Esquimaux,	434	374	808	343	239	582	*72·0*
	Esquimaux, ♀,	426	344	770	326	250	576	*74·8*
	Lapp,	408	304	712	299	205	504	*70·7*
	Lapp, ♀,	360	290	650	280	207	487	*74·9*

When the intermembral index is relatively low, then the bones of the shaft of the upper limb are short in relation to the bones of the shaft of the lower limb, but when it is relatively high, then they more nearly approach them in length. Amongst Europeans the intermembral index, as estimated by Broca, from the measurements of fourteen skeletons, eight men and six women, was 69·73, and by Flower, also from the measurement of fourteen skeletons, 69·2. In my six male Australians it ranged from 72 to 67·4, and the mean of the series was 68·7; in the single female it was 68·3. The mean of the two Oahuans was 67·4, and that of the two Maoris 69·3.

The single Bushman had the intermembral index 67·3. In Fritsch's male I have

calculated an index of 65·2, and in his female 68·5; whilst the corresponding mean index computed from Humphry's measurements of three Bush skeletons was 68·4. The mean of these six skeletons was 67·3. In Fritsch's Hottentot woman this index was 68·8, and in his four male Kaffirs it ranged from 68·6 to 70·3 with a mean of 69·4.

The mean index of my three Negro skeletons was 68·9, and of the two Negresses 68·6. From Professor Humphry's measurements of twenty-five Negro skeletons, I have calculated a mean intermembral index of 68·4, and M. Broca has given 68·27 as the mean index of the sixteen African Negros, ten men and six women, which he measured. A remarkable uniformity runs through the whole of the measurements of the shafts of the limbs in the Negro skeletons, and the intermembral index in this race obviously lies between 68 and 69. The mean index of my three Andaman Islanders was 69·5, which is higher than was obtained by Professor Flower from the measurements of twenty-five skeletons, in which the index was 68·3; that of the males being 69, and of the females 67·5. If my specimens are added to his then the mean of the entire series becomes 68·9.

The mean intermembral index of my three Hindoos was 68·1, and the highest of the series was only 68·9. In the skeleton of the male Sikh this index was also 68·9, but from the measurements given by Dr. Barnard Davis, it would seem that in his Sikh skeleton this index was only 65·8. In my Chinese the intermembral index was 70·3. From Spengel's measurements of his male Chinese I have computed an index of 67·7, the mean of the two skeletons being 69. In my Malay skeleton the intermembral index was 67·7; in one of Barnard Davis's Javanese this index was 70·4, in the other 67·4, and the mean of the three skeletons was 68·5. In Garson's Kubu skeleton the intermembral index was 70.

In both the Esquimaux and the Lapps the intermembral index was remarkably high. The mean of the two Esquimaux was 73·4, and of the two Lapps 72·8.

It would appear, therefore, that there is a certain amount of disparity in the proportion of the shaft of the upper limb to that of the lower limb in the different races of men. If we accept 69·5 as expressing the mean index in Europeans, then it is clear that the black races do not reach that mean, and that the shaft of the upper limb in them is proportionally shorter than the shaft of the lower limb. A similar proportion, if one may judge from the few specimens which have yet been measured, prevails amongst the Mongolians, Malays and natives of India. On the other hand in the Esquimaux and Lapps, and in the Yahgan Fuegians as measured by Garson, the mean index is distinctly higher than in Europeans, and expresses that the upper limb is relatively longer than the lower.

As the maximum lengths of both the femur and humerus are recorded in Table XIV., one can calculate, according to the method of M. Broca, the relative lengths of these two bones, and obtain a *femoro-humeral index* by the following formula $\frac{\text{humeral length} \times 100}{\text{femoral length}}$, the femur being regarded as = 100.

From Broca's measurements of fourteen Europeans, the femoro-humeral index was 72·2, and from Flower's measurements of eleven Europeans 72·9.

In my six male Australians this index varied from 70·5 to 73, and the mean was 71·4, in the single female it was 71. In one Oahuan this index was 68·3, in the other 72, the mean being 70. In one Maori this index was 72·5, in the other 71·5, the mean being 72.

In my Bush skeleton this index was only 68·5. I have calculated the index in Fritsch's Bushman, and find it also 68, but in his Bushwoman it was 73; whilst the mean of the three specimens measured by Humphry was 72. The mean of these six Bush skeletons was 70·3. In Fritsch's Hottentot woman this index was 72; and in his four male Kaffirs it ranged from 68·6 to 72·6, with a mean of 70·6.

The mean femoro-humeral index of my five Negro skeletons was 71·6, and from Professor Humphry's measurements of his twenty-five Negros the mean in them was 71·2; but the mean of the sixteen specimens, ten Negros and six Negresses, measured by M. Broca, was only 68·9. The mean index in my three Andaman Islanders was 70·4, and in Professor Flower's twenty-five skeletons it was 69·8, being 70·3 for the males and 69·2 for the females.

The mean index in my three Hindoos was 70·5. In my male Sikh the index was 71, and from Barnard Davis's measurements the index in his specimen was 66·5. In my Chinese this index was 71·8, and in the Chinese skeleton measured by Spengel it was 68·8. In my Malay the index was 68·2, and in each of Barnard Davis's Javanese it was 69·9. In Garson's Kubu skeleton this index was 75·2.

The mean femoro-humeral index in the two Esquimaux skeletons was 77·7, and in the two Lapps 75·4.

It is clear therefore that differences exist in the relative lengths of the humerus and femur in the different races of men. If we take 72·5 as the mean index in Europeans, then it is obvious that in the black races the mean index falls below that figure, and that in them, therefore, the humerus is shorter in relation to the femur than in Europeans. So far as one can judge from the few specimens of Mongolians, Malays, and natives of India which have been measured, a similar proportion would also appear to prevail in them. On the other hand, in the Esquimaux and Lapps the femoro-humeral index is remarkably high, so that the humerus in them is long in relation to the femur.

I may now refer to the radio-humeral, tibio-femoral, femoro-humeral, and inter-membral indices obtained by the measurements of the bones of the shafts of the limbs in the Anthropoid apes.

The radio-humeral index in three chimpanzees, which I have measured, ranged from 92 to 95, and the mean was 94. From four chimpanzees measured by Professor Humphry, I have calculated a mean index 90. In a single adult orang skeleton in the Anatomical Museum of the University this index was 97·8, the mean of the two

specimens in Humphry's table was 100, and a similar mean was obtained by Flower. In the three gorillas measured by Humphry the mean index was only 77·7; the mean of the three gorillas in Mr. St. George Mivart's tables[1] was 81·6, whilst Flower puts this index in the gorilla at 80. The index in the chimpanzee and orang is therefore very high, and expresses that the forearm closely approximates in length to the upper arm, so that they may be described as hyperdolichokerkic. In the gorilla, on the other hand, there is a much greater disproportion between the length of the radius and humerus, for the mean index is about 80. In this respect the Andaman Islanders and Fuegians surpass the gorilla in the relative length of the forearm to the upper arm, for the radio-humeral index in them averages between 80 and 82, so that in the proportion of forearm to upper arm they are probably the most ape-like of the races of men. Europeans again are at the opposite end of the series, for the mean radio-humeral index in them did not reach 75, whilst the Australians, Kaffirs, Negros, &c., form an intermediate series.

The tibio-femoral index in my three chimpanzees ranged from 81 to 83·5, and the mean was 82·4. Professor Humphry's four specimens gave a mean 80·6. In my single orang this index was 86, and the mean of Humphry's two specimens was 86·8. His three gorillas had a mean 81, and Mr. Mivart's specimens had the same index. In Europeans this index is about 82, whilst in the Australians, Negros, Andaman Islanders, and Fuegians it was higher, and ranged from 83 to 85 or 86, according to the mode of measurement adopted. The difference therefore in the relative length of the tibia to the femur in man, as compared with the chimpanzee and gorilla, is not very marked. In the orang, however, the index rises considerably, owing to the greater proportional length of the tibia, and it is also to be noted that in the lower races of men there is a rise in this index as compared with Europeans, so that as regards the proportion of leg to thigh they are more in accordance with what is found in the orang.

The femoro-humeral index in my three chimpanzees ranged from 94 to 100·3, with a mean of 97·7, so that the humerus sometimes exceeded the femur in length. The mean index computed from Humphry's measurements of four chimpanzees was 98, and Flower places it at about 100. In the orang the humerus is much longer than the femur, and in my specimen the femoro-humeral index was 133·4, the mean of Humphry's two specimens was 132, and Flower gives it as 130. In the three gorillas measured by Humphry the humerus was longer than the femur, though not in the same proportion as in the orang, and the mean index was 119; in Mivart's specimens the mean index was also 119, and in Flower's 120. There is thus a considerable range of difference in the relative proportions of femur to humerus in the great Anthropoid apes, for, whilst in the orang and gorilla the humerus considerably exceeds the femur in length, in the chimpanzee these bones are almost equal and as a rule the femur is somewhat longer than the humerus.

[1] On the Appendicular Skeleton of the Primates, *Trans. Roy. Soc. Lond.*, 1867.

In all the races of men the femur very materially exceeds the humerus in length, but the proportionate excess is not the same in all the races which have been measured. We may, I think, accept 72·5 as expressing the mean femoro-humeral index in Europeans. In the Lapps and Esquimaux, if I may take the four skeletons which I have measured as average samples of these races, the mean index rises considerably above the European standard, and of all the races the bones of whose limbs have been measured, they show the greatest proportion of humeral length, and approximate therefore to, though still widely removed from, the proportion in the ape. On the other hand the black races of Australia and Africa, the Pacific Islanders and the Negritos of the Andaman Islands, all have a less femoro-humeral index than the Europeans. It is probable that in the Chinese, Malays, and the natives of India, the humerus is also shorter in relation to the length of the femur than in the Europeans. It follows therefore that, in the relative proportion of femur to humerus, the European, and still more the Laplander and the Esquimaux, possess a character approaching more to the ape than those black races, which from certain other characters we are in the habit of speaking of as the lower races of mankind.

The intermembral index in my three chimpanzees ranged from 102 to 107, with the mean of 104·6, and in Professor Humphry's specimens the mean index was 103·5; the bones of the shaft of the upper limb, therefore, somewhat exceeded in length the bones of the shaft of the lower limb. In the orang these bones in the upper limb were very materially longer than those in the lower limb; in my specimen the index was 141, and the mean of Professor Humphry's two skeletons was also 141. In the gorilla the upper limb, though longer than the lower, is intermediate in its relative proportions to the chimpanzee and orang; the mean intermembral index of Professor Humphry's three specimens was 117, and the index computed from Mr. Mivart's measurements was 119.

In all the races of men the length of the bones of the shaft of the lower limb was very considerably in excess of that of the bones of the upper limb, so that the intermembral index was much below 100. But amongst these races a range of variation within certain limits was recognised. In Europeans the mean intermembral index was obviously about 69·5, but in the Lapps, Esquimaux, and Fuegians this index was distinctly higher than in the Europeans, so that in this respect these races approached nearer to the ape in this character. On the other hand this index in the black races was distinctly below the European mean, and it is probable that a similar lower ratio will be found when more extensive measurements have been made of Mongolians and Malays.

From the comparison which has now been made of the relative proportions of the bones of the shafts of the limbs, one arrives at the conclusion, that such a physical degradation as is implied by the possession of characters which approximate to those of the Anthropoid apes, is not constantly found in one particular race or group of races, as to lead one to say, that in all respects, in the proportions of their limbs, such race or group of races is constructed on a more ape-like pattern than the other races. In the relative length of

the radius to the humerus, as expressed by the radio-humeral index, the Europeans, Lapps, Esquimaux, and it may be the Bushmen were furthest removed from the apes, the Andaman Islanders and Fuegians most closely approached them, whilst the Australians, Kaffirs, and Negros were intermediate. In the relative length of the tibia to the femur, as expressed by the tibio-femoral index, the Europeans, and still more the Lapps and Esquimaux were amongst the races in which the leg was the shortest in relation to the thigh. In the black races generally, more especially in the Andaman Islanders, as well as in the Fuegians, the proportionate length of the tibia increased, so that the relation of tibia to femur was almost the same as in the orang.

On the other hand in the proportion of femur to humerus, as expressed by the femoro-humeral index, the Lapps and the Esquimaux approximated most closely to the apes, the black races of men were furthest removed from them and the Europeans were intermediate. Similarly in the proportions of the bones of the shaft of the lower limb, compared with those of the upper limb, as expressed by the intermembral index, the Lapps, Esquimaux, and Fuegians most closely approximated to the apes, the Europeans were less near, and the black races were still further removed. It follows therefore that whilst the black races approached more closely to the apes than did Europeans in the relation which the two segments of the shaft in the same limb bore to each other; they were more widely removed from the apes in the relations which the bones of the shaft of the upper limb bore to those of the lower extremity.

As regards the Anthropoid apes themselves, the orang had a radio-humeral index furthest removed from man, the chimpanzee came next in order, whilst in the gorilla this index most closely approached to the mean of that of man. In the tibio-femoral index the orang was also the furthest removed from the average man, whilst both the chimpanzee and gorilla were nearer both to each other and to him. In the femoro-humeral index the orang was widely removed from the human proportion, the gorilla less so, and the chimpanzee least of all. In the intermembral index the orang was also widely removed from man, the gorilla came next, whilst the chimpanzee most nearly approached him. It follows, therefore, that in the proportions of the limbs of these Anthropoid apes, the orang was the most widely separated from man, the chimpanzee the most closely approximated, and the gorilla was intermediate in position.

I have not entered into the consideration of the characters of the skeleton of the distal segments of the limbs, the Hand and the Foot. For although their bones were more or less perfectly preserved in several of the skeletons, yet I did not think them to be sufficiently numerous to enable me to arrive at any general conclusion.

GENERAL SUMMARY.

It may now be useful to gather together into a short chapter a summary of the leading facts and conclusions, which have been stated in more or less detail in the preceding pages. As regards the conclusions, I must again guard myself by saying that in some instances they are to be looked upon only as provisional, for the number of skeletons of several of the races examined and measured, both by other anatomists and by myself, is as yet too few on which to speak in more than a tentative way.

We may take for our standard of comparison the Europeans, as illustrated especially by the French, Germans and British, whose skeletons have so frequently and in such numbers been examined and described by anatomists. The European pelvis is large and roomy. In its external dimensions its breadth materially exceeds its height, so that the breadth-height index in men is about 79, and in women 74 or 75. The pelvic inlet is considerably wider in the transverse than in the conjugate diameter; the brim index is distinctly below 90 both for men and women, and is platypellic. The sacrum both in men and women is broader than long, so that it is platyhieric. The lumbar curve of the spinal column, as estimated both by the relative depth of the front and back of the vertebral bodies, and by that of both the bodies and discs when in position, is greater in front than behind, *i.e.*, kurtorachic. The mean scapular index is about 65. The radius is short in relation to the length of the humerus, *i.e.*, brachykerkic. The tibia is short in relation to the femur, *i.e.*, brachyknemic. The humerus is long in relation to the length of the femur, and the femoro-humeral index is moderately high. The shaft of the upper limb is long in relation to the shaft of the lower limb, and the intermembral index is moderately high. The skull may be either dolichocephalic, or mesaticephalic, or brachycephalic, but the face is orthognathous.

If we now examine the skeletal characters of the black races we shall find that in many particulars they differ from the Europeans, and also differ amongst themselves. In the Bush race the pelvis in its external dimensions is high in proportion to its breadth, and the ilium approximates to the vertical in direction. In the Australians again, the external dimensions of the pelvis are not unlike those of Europeans, and a similar proportion of breadth and height also exists in Negros. In the Negritos of the Andaman Islands, on the other hand, the height of the pelvis increases in relation to its breadth, and the breadth-height index is relatively high. The conjugate diameter of the pelvic brim is long in relation to the transverse diameter, and the brim index is high, or dolichopellic, in Australians, Bushmen, Hottentots, Kaffirs and Andaman Islanders; but in Negros, Tasmanians and possibly the Melanesians of the Pacific Islands the conjugate diameter is not so long in relation to the transverse, and the brim index is not so high, or mesatipellic. In all these black races except the Negros, and it

may be the Melanesians, the average length of the sacrum is greater than its average breadth, and the bone is dolichohieric.

The lumbar curve of the spinal column, as determined by the depth of the bodies of the vertebræ, and without taking into consideration the influence exercised by the intervertebral discs, is concave forwards in the black races. The clavicle, at least in the Negros, may possibly be longer in proportion to the humerus than in Europeans. The scapular index in Negros, Andaman Islanders, and Melanesians, is apparently materially higher than in Europeans, which shows that the breadth is proportionally greater than the length; in the Bush and Australians, it approximates to the Europeans, and in the Tasmanians it may have been distinctly lower. The radius is longer in relation to the humerus than in Europeans, and whilst the index in the Andaman Islanders and other Negritos is dolichokerkic, in the Australians, Tasmanians, Kaffirs, and Negros it is mesatikerkic. The tibia in the black races is long in relation to the femur and the index is dolichoknemic. The humerus in the black races is short in relation to the length of the femur and the femoro-humeral index is low; similarly the shaft of the upper limb in them is proportionally shorter than the shaft of the lower limb, and the intermembral index is relatively low. The cranium is dolichocephalic and prognathous in Australians, Negros and Melanesians, dolichocephalic and perhaps mesognathous in Kaffirs, mesaticephalic and prognathous in Tasmanians, mesaticephalic and orthognathous in the Bush race.

Our information on the skeletal characters of the yellow races is, unfortunately, scanty. In the Chinese the pelvis would appear to have the transverse diameter of the brim considerably in excess of the conjugate, and the brim index, therefore, platypellic; but the relative length and breadth of the sacrum is still doubtful. The lumbar curve, estimated from the vertical diameter of the vertebral bodies, is in all probability kurtorachic. The scapular index is probably about the same as in Europeans. The radius is longer in relation to the humerus than in Europeans, it is mesatikerkic. The proportionate length of the tibia and femur is more like that of the white than of the black races, so that it is brachyknemic. The humerus is possibly shorter in relation to the femur than in Europeans, and a similar relation may prevail in regard to the shaft of the upper limb as compared with that of the lower. The skull of the Chinese belonging to the skeleton described in this Report was brachycephalic, C.I. 81·7; metriocephalic, V.I. 73·7; orthognathous, G.I. 96·8; leptorhine, N.I. 47; megaseme, O.I. 89·5; brachyuranic, P.M.I. 128.

In the Malays the conjugate diameter of the pelvic brim is, for the male sex, in all probability either greater than, or about equal to the transverse, and the brim index is dolichopellic; the sacrum is longer than broad and the bone is dolichohieric. The vertical diameter of the bodies of the lumbar vertebræ may possibly be greater collectively anteriorly than posteriorly. The scapular index is higher than in Europeans. Possibly

the proportion of the radius to the humerus is higher than in Europeans. Data are wanting for giving the relative length of the tibia and femur. It is possible, however, that the Malays, like the Chinese, may have the humerus shorter in relation to the femur, and the shaft of the upper limb shorter in relation to that of the lower limb than in Europeans. The skull of the Malay belonging to the skeleton described in this Report was characterised by great parieto-occipital flattening, so that the cephalic index was abnormally high, 91, and also the vertical index, 87. It was orthognathous, G.I. 93·9; leptorhine, N.I. 41; megaseme, O.I. 95; brachyuranic, P.M.I. 127.

In the American Indians the transverse diameter of the pelvic brim decidedly exceeds the conjugate; the brim index is platypellic. The Yahgan Fuegians have a similar relation. The sacrum is broader than long both in the Indians of the American continent and in the Fuegians. The scapular index approximates to that of Europeans. In the continental Indians the radius is apparently a little longer in proportion to the humerus, and the index is mesatikerkic; but in the Fuegians its proportional length is still greater, and the index is dolichokerkic. The tibia is long in relation to the femur, dolichoknemic, both in the continental Indians and the Fuegians, and in the Fuegians the upper limb is relatively longer than the lower. The continental American Indians are, with the exception of some tribes, brachycephalic, and perhaps mesognathous; the Fuegians again are mesaticephalic and mesognathous, though individual crania have dolichocephalic proportions.

In both the Lapps and Esquimaux the index of the pelvic brim is probably platypellic, and the sacral index platyhieric. The collective vertical diameters of the bodies of the lumbar vertebræ is probably greater in front than behind. The scapular index is apparently distinctly below that of Europeans. The radius is short in relation to the humerus, brachykerkic. The tibia is short in relation to the femur, brachyknemic. The humerus is long in relation to the femur, and the upper limb is relatively long in proportion to the lower. Although in their general characters the skeletons of my Lapps and Esquimaux present many points of similarity, yet they differ materially in certain of their craniological aspects. Both the Lapp skulls are markedly brachycephalic (C.I. 86·5 male, 86·7 female), and the Esquimaux dolichocephalic (C.I. 74 male, 70·8 female). They all agree, however, in having the vertical index below the cephalic; in the two Lapps this index is 76·5 and 69·7, and in the two Esquimaux 70·8 and 68. In the male Lapp the gnathic index is orthognathous, in the female mesognathous, and the same applies to the male and female Esquimaux. In both Lapps and Esquimaux the nasal index is leptorhine. In both the Lapps, the orbital index is megaseme; in both the Esquimaux, mesoseme. In the male Lapp the palato-maxillary index is brachyuranic, in the female mesuranic; in the male Esquimaux this index is mesuranic and in the female dolichuranic.

I have not sufficient material to enable me to make a satisfactory general statement of

the skeletal characters of the natives of India, but I should like to bring into the compass of a single paragraph the main features of the skeletons of the Sikh and the tall Hindoo. In both, the index of the pelvic brim was on the verge between platypellic and mesatipellic, and the sacrum was platyhieric. In both, the vertical diameter of the bodies of the lumbar vertebræ was greater behind than in front. In both, the scapular index was between 68 and 69. In both, the radio-humeral index was mesatikerkic. In the Hindoo the relative length of the tibia to the femur was somewhat greater than in the Sikh. In the femoro-humeral and intermembral indices they were almost identical. As regards their craniological characters they were both hyper-dolichocephalic, C.I. 66·5 for the Hindoo, 65·8 for the Sikh. In both, the vertical diameter exceeded the transverse breadth, the vertical index being 68·6 for the Hindoo, 71 for the Sikh. Both were distinctly orthognathous, 95 and 90·7. In the Hindoo the nasal index was platyrhine, 54, in the Sikh leptorhine, 47. In the Hindoo the orbital index was megaseme, 97, in the Sikh microseme, 71. In the palato-maxillary index both were brachyuranic, 123 and 117. Although certain differences in their proportions existed between the two skeletons, yet in their main features they corresponded so closely to each other, that although the skeleton, which throughout I have designated as the tall male Hindoo, belonged as Dr. Anderson told me, to a man of Hindoo religion, yet it is possible that he may have been a Sikh by race.

Notwithstanding the incompleteness, and consequent imperfection, of many of the data for making a detailed comparison of the skeletal characters of the several races of men described or referred to in this Report, there is sufficient information to enable one to say that racial differences are not confined to the skull, but occur also in other parts of the skeleton. The question therefore naturally arises, are these differences of such a degree or kind as to point to one race, or group of races, as being in all the relations of the skeleton more highly developed than all other races? or to another race, or group of races, as being in all the skeletal relations more lowly developed than all other races? By highly developed I mean a condition of the skeleton which is further removed either from the characters and proportions of the skeleton in mammalia other than man, or from the infantile condition of man himself; and by lowly developed, one which is either more closely approximated to the mammalian characters and proportions, or to the infantile condition of the human skeleton. In other words, is there in the different varieties or races of men such a graded condition of the skeleton as would indicate, that by successive stages a human type had been produced which in all its skeletal relations was superior to all other forms of humanity; and that the stages, through which the skeleton had passed to reach that type, were represented by the various races which either now inhabit, or at some former epoch have inhabited, the different parts of the globe.

Although our knowledge of the races which inhabited the earth in the early parts of the human period is very imperfect, researches made during the latter half of the

present century, in different parts of Europe, have brought to light both skulls and skeletons, which are referred to the time when the mammoth, the reindeer, and the cave bear were the mammals of the south of Europe. Apparently at that epoch, as at the present, three different forms of human skull occurred, dolichocephalic, mesaticephalic, and brachycephalic. The dolichocephalic skulls are represented by the Neanderthal cranium and the skulls of Canstadt, Würtemberg, and of the cave-dwellers of Cro-Magnon in the valley of the Vézère; mesaticephalic skulls have been found at Furfooz in the valley of the Lesse, Belgium, and brachycephalic skulls have been discovered in gravel pits at Grenelle, near Paris, and at La Truchére.[1] As in the skulls of the present day, some of these ancient crania, in which the face has been preserved, have a prognathic condition of the upper jaw, whilst others are orthognathic. In their internal capacity many of these crania are equal to the mean of modern European skulls. The vault of the skull is in a number of specimens arched, as in all well-formed crania, though in others, as the Neanderthal skull, it is more depressed and associated with strongly projecting glabella and supraciliary ridges.

In many of the skeletons of these primitive men, especially those from Cro-Magnon, a large proportion of the tibiæ were platyknemic; the femora were prismatic, and with a strongly projecting linea aspera; and the humeri were perforated by a supratrochlear foramen in the olecranoid fossa. As has been pointed out in the description of the skeletons of the existing races described in this Report, instances of a corresponding conformation of these bones not unfrequently occurred.

Amongst existing races of men, therefore, craniological and skeletal characters are met with similar to those which have been recognised in the most ancient human remains that have yet been discovered,[2] and the differences that exist between the skulls and skeletons of primitive man are no more, either in kind or degree, than are to be seen in the corresponding parts in the men of the present day.

In the examination of the skeletons of existing races of men, characters sometimes present themselves in certain races which one recognises as more in accordance with the ordinary mammalian arrangement than is the case in the corresponding parts of other races. For example, in adults of the black races the conjugate diameter of the pelvic brim tends to preponderate over the transverse diameter, and the forearm to be longer in proportion to the upper arm, than in adults of the white races, so that it may be said that in these respects the white man is more highly developed than the black man. In other words, the adult skeleton in the white man, in the relative proportions of these parts, is further removed from the proportions found both in lower mammals and in the infantile

[1] The characters of these crania have been most carefully described by MM. de Quatrefages and Hamy in their great work, Crania Ethnica.

[2] Some years ago I pointed out that skulls of the Neanderthaloid type were closely paralleled in the crania of many existing savage races as well as in modern Europeans, *Quarterly Journal of Science*, April and October, 1864. See also de Quatrefages, L'espèce humaine, and Verneau, La race de Cro-Magnon, *Revue d'Anthropologie*, January 1886.

condition of man himself, than is the case with the black man. But, on the other hand, as has indeed been already stated on p. 114, in the proportions of the shaft of the lower limb to the shaft of the upper limb, and of the thigh to the upper arm, the black races are more widely removed from the apes than are Europeans, and the tendency to produce a femur with a prismatic shaft, which is the very opposite to a pithecoid character, is more marked in the Australians than in the white or yellow races. Also, whilst the Lapps and Esquimaux, of all the races which I have measured, most closely approach the apes in the proportions of thigh to upper arm, and of shaft of lower limb to shaft of upper limb, they are amongst the races most widely removed from the apes in the proportions of forearm to upper arm, and of leg to thigh. The Yahgan Fuegians, again, whilst they are, in the proportions of forearm to upper arm, the most ape-like of men, yet possess a platypellic pelvis and a platyhieric sacrum.

I do not find, therefore, in the comparative study of the skeleton in the Races of Men, evidence that any one race dominates in all its characters over all other races; or that any one race, in all its characters, is lower than all other races. Nevertheless there can be no doubt that Europeans in many of their most important skeletal characters, more especially those of the skull and pelvis, are more widely removed from mammals generally, than is the case with Negros, Kaffirs, Bushmen and Australians. There does not seem, however, to be a graded arrangement, such as would lead one to say that the white races, which we will assume to be the most highly developed, have been derived, by successive stages of slow and gradual perfecting of structure, from the lowest existing black race, or, indeed, from any one of the existing black races.

Weisbach concludes his analysis of the measurements of the body in living individuals of different races of men, taken during the voyage of the "Novara" by Drs. Scherzer and Schwarz,[1] by stating that resemblances in form and proportion to characters observed in apes are in no way exclusively concentrated in any single race, but are distributed amongst different races, in some in one direction, in others in another direction, and that even Europeans themselves are not free from such characters. Moreover, he regards these resemblances as evidence of the descent of man from an ape-like ancestor.

In concluding this Report I have no intention to enter into a discussion of any speculative question connected with the remote origin of man. But this I may say, that in the form and proportion of the different parts of the skeleton, so far as I have made them objects of study, the so-called simian characters are not such as would lead any competent anatomist, either to mistake a human bone for the bone of an ape, or to say that in the fossil remains of man, so far as we know them, there is evidence that a transitional form between man and the higher apes at one time existed.

[1] Reise der Novara, Anthropologischer Theil, p. 269, Wien, 1867.

APPENDIX TO PART I. ON THE HUMAN CRANIA.

Since the publication of the Craniological part of this Report in 1884, I have received additional specimens of skulls of certain of the races then described, and in order to give a larger basis for comparison, and for the determination of the characters of the skulls of these races, I append some tables of measurements of these more recent specimens, with brief notices of such of their features as seemed to be deserving of special remark. As memoirs on the Fuegians and on the Crania of the Jervis Islanders, Torres Strait, have also been published subsequently to the appearance of my Report on the Human Crania, in which skulls of these people were described, I shall also briefly refer to the chief facts stated and conclusions arrived at by their respective authors.

Australians.

After the tables of measurements of the Australian skulls described in Part I., Report on Human Crania, had been put in type, I had the opportunity of examining some additional Australian crania, and I incorporated some observations on their characters in subsequent pages of that Report (p. 46, *et. seq.*), more especially with reference to the proportions of the cephalic and vertical indices. I have now included in Table XV. more detailed measurements of five of these skulls, which have been presented to the Anatomical Museum of the University, and along with them have given the measurements of two other crania from New South Wales, received in 1885. The localities from which these skulls were obtained are stated in the table.

Each skull was dolichocephalic. In four specimens the vertical index exceeded the cephalic, and in two specimens the cephalic and vertical indices were equal. In only one specimen, viz., the Milang tribesman, the height was greater than the breadth, so that, as stated on p. 49 of Part I., it was markedly dolicho-platycephalic. With two exceptions the vertical index was below 72, *i.e.*, they were tapeinocephalic, and those with the vertical index above 72 were metriocephalic. The gnathic index ranged from 98 to 101, so that they were all mesognathous. In the nasal index four were platyrhine and two

Table XV.—Australians and New Zealander.

Collection,	Rockhampton. Queensland.	Rockhampton. Queensland.	Curtis Island, Lat. 23°, Queensland.	Interior of South Australia.	Milang Tribe, S. Aust.	Manly Cove, N. S. W.[1]	New South Wales,[2] Lat. 30° 27'.	Te Aroha, Auckland, N. Z.
	E.U.A.M.	E.U.A.M.	E.U.A.M.	E.U.A.M.	E.U.A.M.	E.U.A.M.	E.U.A.M.	E.U.A.M.
Age,	Ad.	Aged.	Ad.	Ad.	Ad.	Ad.	Aged.	Ad.
Sex,	M.	M.	F.	?	M.	M.	F.	F.
Cubic capacity,	1330	1285	1240	...	...	1223	998	1472
Glabello-occipital length,	192	192	183	180	191	186	173	186
Basi-bregmatic height,	137	138	133	128	125	140	122	134
Vertical Index,	*71*	*71·9*	*72·7*	*71*	*65*	*75*	*70·5*	*72*
Minimum frontal diameter,	97	97	97	...	91	94	90	96
Stephanic diameter,	105	105	104	...	98	103	98	108
Asterionic „	107	110	103	...	110	112	113	110
Greatest parieto-squamous breadth,[3]	133	132	131	128*ap*	130	132*a*	122*a*	135*a*
Cephalic Index,	*69*	*68·8*	*71·6*	*71*	*68*	*71*	*70·5*	*72·6*
Horizontal circumference,	532	538	510	...	531	530	500	520
Frontal longitudinal arc,	140	...	135	...	122	130	119	125
Parietal „ „	135	...	132	...	124	135	125	118
Occipital „ „	118	...	111	...	115	114	106	118
Total „ „	393	383	378	...	361	379	350	361
Vertical transverse arc,	303	304	295	...	275	300	272	298
Basi-nasal length,	104	108	97	...	105	101	94	107
Basi-alveolar length,	102	106	97	...	...	101	95	102
Gnathic Index,	*98*	*98*	*100*	...	...	*100*	*101*	*95*
Interzygomatic breadth,	135	138	134	...	135	134	120	136
Internalar „	114	122	120	...	125	122	107	121
Naso-alveolar length,	60	61	57	...	...	70	63	60
Nasal height,	45	50	45	...	46	52	47	56
Nasal width,	25	27	25	...	26	26	25	24
Nasal Index,	*55·5*	*54*	*55·5*	...	*56ap*	*50*	*53*	*42·8*
Orbital width,	41	42	39	...	43	40	39	40
Orbital height,	34	33	33	...	31	34	31	34
Orbital Index,	*82·9*	*78·6*	*84·6*	...	*72ap*	*85*	*79·5*	*85*
Palato-maxillary length,	58	65	58	...	...	60	58	56
Palato-maxillary breadth,	64	65	63	...	...	70	58	67
Palato-maxillary Index,	*110*	*100*	*108*	...	...	*116*	*100*	*109*
Symphysial height,	...	...	...	...	...	32	29	33
Coronoid „	...	...	...	...	...	62	54	68
Condyloid „	...	...	...	...	...	63	55	64
Gonio-symphysial length,	...	...	...	...	...	99	85	91
Inter-gonial width,	...	...	...	...	...	102	77	96
Breadth of ascending ramus,	...	...	...	...	...	37	32	35

[1] With skeleton: presented by Professor Anderson Stuart.

[2] Dr. Chisholm Ross, who sent me this skull, wrote that it belonged to a very old woman, the people of her tribe having credited her with being 130 years old. Although the skull shows marks of age in the almost complete obliteration of the sutures of the cranial vault, the deep depressions on the facial aspect of the upper jaw and the obtuse angle of the lower jaw, yet eleven teeth had survived in the upper and nine in the lower jaw, although they were much worn down.

[3] To avoid any misunderstanding, I have altered this heading from greatest parietal breadth, as in the former Tables, to greatest parieto-squamous breadth, for in all my measurements I have taken the greatest breadth of the cranium, whether it occur in the bi-parietal or bi-squamous diameters.

mesorhine. In the orbital index four were microseme and two mesoseme. In the palato-maxillary index three were dolichuranic, one mesuranic, and one brachyuranic. Both males and females were microcephalic.

In three adult males the maximum length of each cranium exceeded 190 mm. They were all adults, and in three the sutures on the vault had almost or entirely disappeared, in two evidently from age, and in the third, the Manly Cove skull, the cranial vault was marked with pits and eminences probably due to blows from a waddy. In their general characters the crania conformed to the description which I have previously given of the Australian skull. In the Manly Cove skull the right central incisor had been extracted in early life and the socket absorbed, but the sockets of all the other teeth were patent. The skull from Curtis Island showed remains of the infraorbital suture on each side.

New Zealander.

Table XV. also contains the measurements of a skull procured from the same cave at Te Aroha, Auckland, in which the pelvis and long bones already described were found, but not belonging to the same skeleton. It was the skull of a woman apparently about thirty years old, and was in good preservation. The cranium was dolichocephalic and of almost the same diameter in height as in breadth. The gnathic index was orthognathous, the nasal index mesorhine, the orbital index mesoseme, the palato-maxillary index dolichuranic and the internal cranial capacity mesocephalic. The teeth were all erupted and but little worn. The infraorbital suture was complete on the left side, but incomplete on the right.[1] The alisphenoid only just reached the antero-inferior angle of the parietal.

Sandwich Islanders.

Early in the year 1886 I received for the Museum, through R. A. Macfie, Esq., of Dreghorn, a box containing five adult crania collected by Dr. G. W. Parker of Waiahia, Oahu. In his letter accompanying the crania Dr. Parker wrote as follows :—

Yesterday I rode to an ancient burial place, where I managed to secure the bones of an almost complete Hawaiian skeleton, also some skulls and jaws. I was so fortunate as to find *in situ* the entire upper half of one skeleton, and to note the method of burial, if not of the ancient Hawaiians in general, at least of this particular one, viz., with arms bent, so as to bring the hands on to the upper part of the sides of the chest, and head bent forward upon the chest. The lower jaw was still in the natural position. From the loins downward the rest of the skeleton had disappeared, owing to movements of the shifting sandhill on the top of which it had been buried, only ten or twelve inches below the surface. This burial-place is in a line of shifting sand-

[1] See my remarks on this suture in *Journ. of Anat. and Phys.*, vol. xix. p. 218, January 1885.

hills near the beach, in a district once full of inhabitants, now depopulated. As to its origin some persons say that a great battle was fought there in the prehistoric ages of Hawaiian history, others that it was one of the places used for burying those who died of one or other of the epidemic diseases which killed off thousands of the Hawaiians in very recent times. But I particularly took note that none of the skulls which I examined (about a dozen), bore marks suggesting death by violence, nor were any weapons discoverable; so that I should be inclined to credit the second theory of origin, unless it could be ascertained whether the coast tribes were in the habit of choosing sandy places for the sake of convenience, just as we know that those of more stony places chose caves. Further, the bodies appear to have been buried naked, no traces of matting or cloth of any kind being found with the skeletons. The custom of knocking out the front teeth, or in any way injuring the teeth, did not exist among the natives of these islands, for most of the teeth in the jaws are sound.

These crania had been buried in a similar locality to that at Waimanolo, Oahu, from which Professor Moseley obtained the skulls described in the first part of this Report. Like them they were for the most part bleached perfectly white from exposure. One skull (1A) was brachycephalic, with a length-breadth index 81 (Table XVI.); one (1D) was in the lower term of the mesaticephalic group with an index 75·1, and the remaining three were dolichocephalic, with a mean cephalic index 71·9. They presented, therefore, that variety in the proportions of length and breadth of the cranium, which in the first part of this Report I had dwelt on at considerable length as present in the crania from Oahu, although the range of variation was not so great in this limited as in that much more extensive series.

The brachycephalic cranium, that of a woman, showed its character not only in its numerical proportions, but in the downward slope of the parietal bone from the obelion to the inion. In it the basi-bregmatic height was slightly below the parieto-squamous breadth, the vertical index was 80, and the skull was akrocephalic, as in the brachycephalic Sandwich Islanders, both from Hawaii and Oahu, described in the first part of the Report. In its other relations the skull was orthognathic, leptorhine, megaseme, brachyuranic and mosocephalic. It did not in all of these quite correspond with the mean of the brachycephalic Oahuans previously described, which were mesognathic, mesorhine, megaseme, brachyuranic, and mesocephalic.

The skull 1D, although in the numerical proportion of length and breadth it just fell into the mesaticephalic group, obviously in its general characters closely corresponded with the three dolichocephalic crania, and may be considered along with them. Like the dolichocephalic Oahuans described in the first part of this Report, they were all somewhat ridge-shaped on the top of the cranium, and in their general appearance were strong, powerful skulls. In two specimens the sutures of the cranial vault were in process of senile obliteration. In each of the three dolichocephalic skulls the basi-bregmatic height exceeded the greatest breadth, and in the mesaticephalic skull the breadth was only 1 mm. more than the height; one was tapeinocephalic, two were metriocephalic, and the third was akrocephalic. All four skulls were mesognathous. Two of the specimens were leptorhine and two mesorhine. As to the orbital index, one was microseme, two meso-

séme, one megaseme. In the palato-maxillary index one was dolichuranic, another mesuranic; in the remainder this index could not be determined. The woman's cranium was microcephalic and each of the men's skulls was megacephalic, though 1D and 1E were only just within the limits of that group.

Two of the skulls gave illustrations of exostoses, growing from the wall of the external auditory meatus to which I referred in the first part of the Report, p. 117, as not uncommon amongst the South Sea Islanders; in one the bony growths were elongated,

TABLE XVI.—OAHU, SANDWICH ISLANDS. NEW GUINEA.

	Oahu, Sandwich Islands.					New Guinea.
Collection,	E.U.A.M. 1A.	E.U.A.M. 1C.	E.U.A.M. 1B.	E.U.A.M. 1D.	E.U.A.M. 1E.	E.U.A.M.
Age,	Ad.	Aged.	Ad.	Aged.	Ad.	Youth.
Sex,	F.	F.	M.	M.	M.	F.
Cubic capacity,	1362	1200	1545	1453	1457	...
Glabello-occipital length,	171	185	191	189	188	183
Basi-bregmatic height,	137	131	142	141	146	127
Vertical Index,	*80*	*70·8*	*74*	*74·6*	*77·7*	*69·4*
Minimum frontal diameter,	88	93	89	96	93	89
Stephanic diameter,	107	102	111	104	108	101
Asterionic „	108	108	115	110	109	98
Greatest parieto-squamous breadth,	139p	129p	139p	142s	138s	119p
Cephalic Index,	*81*	*69·7*	*72·8*	*75·1*	*73·4*	*65*
Horizontal circumference,	498	510	535	538	530	495
Frontal longitudinal arc,	120	124	132	130	134	117
Parietal „ „	122	132	130	131	129	139
Occipital „ „	120	113	128	122	125	127
Total „ „	362	369	390	383	388	383
Vertical transverse arc,	300	298	320	314	312	280
Basi-nasal length,	96	102	105	106	106	91
Basi-alveolar length,	87	103	105	104	103	93
Gnathic Index,	*90·6*	*101*	*100*	*98*	*97*	*102·2*
Interzygomatic breadth,	124	122	141	135	138	108
Intermalar „	108	112	123	120	120	94
Naso-alveolar length,	60	60	75	65	69	57
Nasal height,	47	49	58	55	55	41
Nasal width,	22	25	26	28	23	20
Nasal Index,	*46·8*	*51*	*44·8*	*50·9*	*41·8*	*48·8*
Orbital width,	36	38	38	39	39	37
Orbital height,	33	33	35	32	33	31
Orbital Index,	*91·7*	*86·8*	*92*	*82*	*84·6*	*83·8*
Palato-maxillary length,	48	58	55	55	54	54
Palato-maxillary breadth,	58	60	62	...	...	59
Palato-maxillary Index,	*120*	*103*	*112*	...	...	*109*
Symphysial height,	26	29	35	...	32	28
Coronoid „	58	60	78	73	65	53
Condyloid „	58	54	69	61	67	53
Gonio-symphysial length,	82	85	96	92	89	77
Inter-gonial width,	81	85	97	92	...	71
Breadth of ascending ramus,	35	39	40	41	35	31

with wide bases of attachment, and as many as three in each meatus; in the other they were more pedunculated, two in one meatus, three in the other. In two skulls the left outer incisor was absent and its socket absorbed; possibly these teeth had been extracted at the time of puberty.

New Guinea.

I gave, on p. 89 of the first part of the Report, a table of measurements of crania from New Guinea, in the Anatomical Museum of the University. During the present year I received through a former pupil, Dr. F. Ashwell of Sidney, a cranium which had been collected by Captain Strachan, who has just returned, I understand, from the interior of New Guinea. It had obviously been suspended in a hut, for a loop of cane was attached to it, and the bones were brown and discoloured with smoke. A cord of twisted vegetable fibre had been tied transversely around the necks of the condyles of the lower jaw, which bone had doubtless been worn as a bracelet. All the permanent teeth had erupted except the four wisdoms, and as the basi-cranial synchondrosis was also not closed, the skull was probably that of a youth about 16 years old.

The measurements are recorded in Table XVI., from which it will be seen that the skull is hyper-dolichocephalic, the index being only 65; the vertical index is tapeinocephalic, 69·4, and it conforms with what I have previously shown to be a character of the dolichocephalic people of New Guinea, in the basi-bregmatic height exceeding the transverse diameter. The parietal longitudinal arc is considerably longer than either the frontal or occipital arcs, and gives to the skull that parieto-dolichocephaly which I have elsewhere stated to be a not unfrequent race character of the Papuans. In its gnathic index the skull is mesognathous, in its nasal index mesorhine, in its orbital index microseme, and in its palato-maxillary index dolichuranic. In the right pterion is an epipteric bone, and the squamous-temporal also articulates with the frontal; the left pterion is normal. I have not definite information of the exact locality in which this skull was collected, but if it came from the interior, it points to a strongly marked dolichocephalic people in that portion of New Guinea.

In the Table already referred to on p. 89, I gave the measurements of a skull from Jarvis or Jervis Island, Torres Strait, collected by the Rev. S. Macfarlane. The same gentleman also forwarded to the Natural History Museum, South Kensington, a collection of forty-nine crania which, like my specimen, were procured from the Sacred House of the Jervis Islanders, and these have recently been described by Mr. Oldfield Thomas.[1] These crania, like the one I had previously described, had been smeared with a red pigment. Like it they were dolichocephalic, and the mean index of fourteen adult

[1] *Journ. Anthropol. Inst.*, vol. xiv. p. 328, 1885.

males was 68·3, and of nineteen adult females 70·1. The mean vertical index of the same skulls was 71·1 for the men, and 72·3 for the women, so that they support the rule that the vertical index is higher than the cephalic in the Papuan skull. The gnathic index, 109 in my specimen, expressed a marked degree of prognathism, which is obviously a common character of these islanders, as Mr. Thomas obtained a mean of 107·1 from thirty-seven skulls, viz., 106·5 for the men, and 107·7 for the women. In my specimen, owing to the palato-maxillary length being greater than the palato-maxillary breadth, the corresponding index was remarkably low, only 95; the mean palato-maxillary index in Mr. Thomas's specimens was 105·4 for both sexes, which, although higher than in my specimen, yet places them along with it in the dolichuranic group. In my specimen the parietal longitudinal arc exceeded the frontal by 10 mm., but in Mr. Thomas's series, the parietal arc was longer than the frontal in only about one-half the total number of skulls, so that it is not a constant character in the skulls of these islanders. His general conclusion regarding the crania which he had examined from Jervis island is that they have long, narrow, and rather low brain-cases, low orbits, heavy frowning brow ridges, short and little prominent nasal bones, small nasal spines, long palates, large teeth, and considerable prognathism, characters which in the main closely correspond with those possessed by the skull which I had described from the same island.

Fuegians.

Since my description of the cranial characters of the Fuegians was published (Part I. p. 17), Dr. Garson has given[1] an account of the crania of seven male and two female Fuegians, of which six males and two females belonged to the Yahgan tribe. His observations are in close correspondence with those which I had previously described in the Report on the Human Crania collected by the Challenger. In my summary of the cranial characters of the Fuegians I stated that they were on the average mesaticephalic, metriocephalic, mesognathic, leptorhine, megaseme, and mesuranic; but I also pointed out that individual skulls had dolichocephalic proportions. The mean features of the crania described by Dr. Garson are in accordance with what I had stated to be the general characters of the Fuegian skull, and he employs for their description the terminology which I had also used, except that he gives the term mesostaphyline instead of mesuranic, to express the palato-maxillary proportions. In one respect there is, however, a difference of statement between us, for whilst I found the mean cubic capacity of four crania to be 1333·5 c.c., so that I placed the skulls in the microcephalic group; Garson says that his skulls were mesocephalic. On referring, however, to his more detailed statements of the internal capacity (p. 151) "calculated by means of a

[1] *Journ. Anthropol. Inst.*, vol. xv. p. 141.

slight modification of Broca's method," I find that he gives 1·452 c.c. for the mean of the males, and 1·245 c.c. for the mean of the females. The mean of these two measurements is therefore 1348, which is below the upper term of the microcephalic series, 1350, as usually defined by craniologists, so that they are in the microcephalic and not in the mesocephalic group. Moreover, Garson has excluded from his average a skull the capacity of which was only 1·210 c.c., and, if that had been included with the rest, his Fuegian crania would have been more decidedly microcephalic. The study of these additional specimens leaves the description of the skull of the Fuegians in much the same position as it had been placed in by my observations, published in the First Part of this Report.

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PLATE I.

PLATE I.

Fig. 1. Pelvis of a Scotsman, Howieson, in the Anatomical Museum of the University of Edinburgh.

Fig. 2. Pelvis of a male Australian from Manly Cove, New South Wales. E.U.A.M.

Fig. 3. Pelvis of a Sandwich Island woman from Oahu. The measurements of the skull of this woman are given in Table XI. of the Report on Human Crania, p. 66. Challenger Collection, I.

Fig. 4. Pelvis of a Maori from Otago, New Zealand. E.U.A.M.

In this and the other plates the pelvis is represented with the anterior superior iliac spines and pubic spines in the same vertical plane. So far as possible, in the series of figures the pelves were reduced uniformly in size.

AUSTRALIAN ♂

MAORI ♂

SCOTSMAN ♂

OAHUAN ♀

W. Turner del.

F. Huth, Lith. Edin.

PELVIS.

PLATE II.

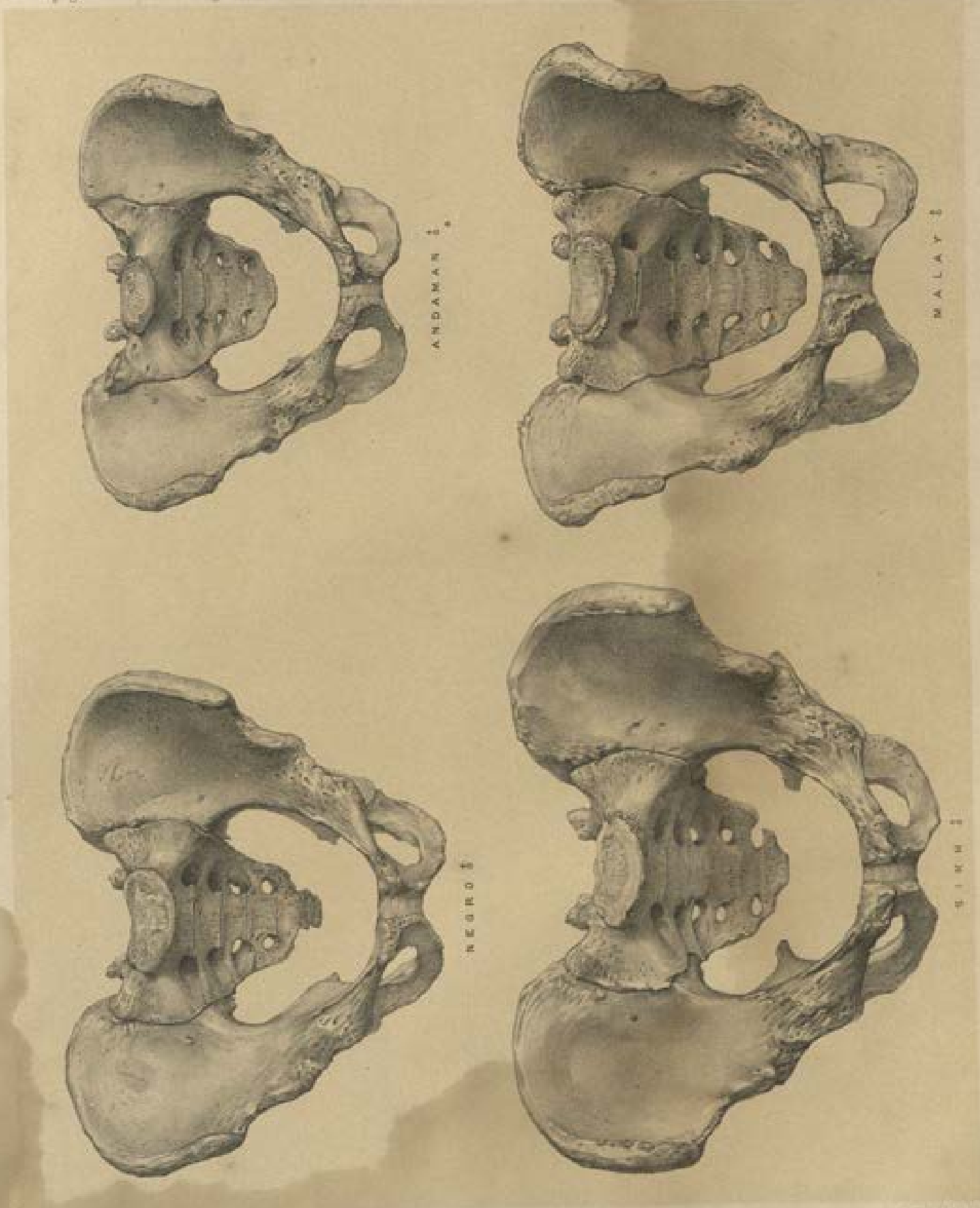
PLATE II.

Fig. 1. Pelvis of a Negro. Monro collection in the E.U.A.M.

Fig. 2. Pelvis of a male Andaman Islander. E.U.A.M.

Fig. 3. Pelvis of a male Sikh. E.U.A.M.

Fig. 4. Pelvis of a Malay. E.U.A.M.



W. Tunnicliffe

J. Huth, Lith. Edin.

PELVIS.

PLATE III.

PLATE III.

Fig. 1. Pelvis of a male Guanche from the Grand Canary Island. E.U.A.M.

Fig. 2. Pelvis of a Bushman from the mountain district at the source of the Umzimkulu River. The skull of the same individual is figured in Plate I. of the Report on Human Crania. E.U.A.M.

Fig. 3. Pelvis of a male Esquimaux, from the Monro collection in the E.U.A.M.

Fig. 4. Pelvis of a male Laplander. E.U.A.M.

BUSHMAN ♀

LAPLANDER ♀

GUANCHE ♀

ESQUIMAUX ♀

PELVIS.

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